

Shelve in Stacks S. B. T.

Highway Safety Literature

An Announcement
of Recent Acquisitions. . .

HSL No. 71-19
July 2, 1971



THIS ISSUE CONTAINS:

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U.S. Department of Transportation / National Highway Traffic Safety Administration

61-1/L
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HIGHWAY SAFETY LITERATURE

AN ANNOUNCEMENT OF RECENT ACQUISITIONS

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Washington, D. C. 20591

INTRODUCTION

Publications announced in *Highway Safety Literature* include the most recent additions to the collection of the NHTSA Scientific & Technical Information Service. Subject areas covered include all phases of highway, motor vehicle, and traffic safety, especially those encompassed by the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966.

Individual issues of *HSL* are numbered according to the year and the issue number within that year; thus, 71 designates the year and 1, 2, 3, etc. the individual issues. To aid the user in location citations by the HS-number, the cover bears the inclusive entry numbers for each issue.

Entries in *HSL* are arranged according to the revised NHTSA Subject Category List shown in the Table of Contents. The List is a two-level arrangement consisting of five major subject fields subdivided into 58 subject groups. Documents related directly to the National Highway Traffic Safety

Administration (NHTSA) are announced in a separate section headed NHTSA DOCUMENTS and are numbered in five distinct series: NHTSA Accident Investigation Reports (HS-600 000 series), NHTSA Compliance Test Reports (HS-610 000 series), NHTSA Contractors Reports (HS-800 000 series), NHTSA Staff Speeches, Papers, etc. (HS-810 000 series), and NHTSA Imprints (HS-820 000 series). For NHTSA DOCUMENTS in series HS-600 000 and HS-610 000, individual full case reports are available for inspection at the National Highway Traffic Safety Administration; or for purchase from NTIS (see page ii). Although announced together in a separate section, these documents are also assigned specific subject categories for machine retrieval.

A document which contains a number of separate articles is announced as a complete volume in the subject category most applicable to it as a whole. Entries for the individual articles appear in their most specific subject category.

SAMPLE ENTRIES

Subject Category Array

NHSB Accession no..... HS-800 218 Fld. 5/21; 5/9
Title of document..... AN INVESTIGATION OF USED CAR SAFETY STANDARDS-SAFETY INDEX: FINAL REPORT. VOL. 6 - APPENDICES G-L
Personal author(s)..... by E. N. Wells; J. P. Fitzmaurice; C. E. Guilliams; S. R. Kalin; P. D. Williams
Corporate author..... Operations Research, Inc.
Collation.....
Publication date..... 12 Sep 1969 150p
Contract FH-11-6921
Report no. ORI-TR-553-Vol-6; PB-190 523
Abstract..... Appendices G-L to this study of used car safety standards include: indenture model diagrams for classes I-IV motor trucks; degradation, wear, and failure data for motor truck classes I-IV; and safety index tables for classes I-IV motor trucks.

Search terms: Wear /Trucks;
Failures /Trucks; Used cars; Inspection standards /Trucks; Inspection standards /Data

AVAILABILITY: NTIS

HS-004 497 Fld. 5/19

AUTO THEFT-THE PROBLEM AND THE CHALLENGE

by Thomas A. Williams, Sr.

Journal citation . . . Published in *FBI Law Enforcement Bulletin* v37 n12 p15-7 (Dec 1968)

Gives figures on the extent of the auto theft problem and comments on anti-theft devices available now or in the planning stage.

Search terms: Theft, Theft protection, Stolen cars

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NOTE: Material published in Highway Safety Literature (HSL) is intended for the information and assistance of the motor vehicle and highway safety community. While brands names, equipment model names and identification, and companies may be mentioned from time to time, this data is included as an information service. Inclusion of this information in the HSL should not, under any circumstances, be construed as an endorsement or an approval by the U. S. Department of Transportation, National Highway Traffic Safety Administration of any particular product, course, or equipment.

Harry A. Feinberg
Managing Editor

**AVAILABILITY OF DOCUMENTS
AND
INSTRUCTIONS FOR ORDERING**

Department of Transportation personnel may borrow copies of publications directly from the NHTSA. Outside the Washington, D.C. area, phone (202) 426-2768. In Washington, D.C. area, use government ID, phone 118-62768. Non-DOT personnel should contact their company or agency libraries for assistance.

Journals cited may be obtained through most research libraries.

Contractors' reports and other documents can usually be obtained as indicated under AVAILABILITY. However, there is no certainty that retention copies will be available for more than a limited period after a document is issued.

The more common distribution sources are identified by symbols which are explained below:

NTIS: National Technical Information Service, Springfield, Va. 22151. *Order by accession number: HS, AD, or PB.* Prepayment is required by NTIS (CFSTI) coupon (GPO coupons are not acceptable), check, or money order (made payable to the NTIS), *HC* (Paper copy; full size original or reduced facsimile) \$3.00 up; *MF* (microfiche approximately 4x6" negative sheet

film; reader required) \$0.95.

GPO: Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402. Give corporate author, title, personal author, and report number. Prepayment is required by GPO coupon (NTIS [CFSTI] coupons are not acceptable), check or money order (made payable to the Superintendent of documents).

HRB: Highway Research Board, National Academy of Sciences, 2101 Constitution Ave., N. W., Washington, D. C. 20418.

NHTSA: National Highway Traffic Safety Administration General Services Division, Washington, D.C. 20591 (Telephone (202) 426-0874),

SAE: Society of Automotive Engineers, Dept. HSL, 2 Pennsylvania Plaza, New York, N.Y. 10001. Order by SAE report numbers. Prices given are list; discounts are available to members and sometimes to libraries and U. S. Government Agencies. Prepayment is required; orders without payment are subject to a \$1 handling charge.

IMPORTANT NOTICE

WHEN REQUESTING a document, to be absolutely sure you receive what you order, give the accession number (HS, PB, AD number) or report number (in cases such as an SAE document), title of report, and the personal or corporate author (whichever is cited). When requesting an HS-numbered document from NTIS (CFSTI), add DOT/to the prefix HS-; example HS-800 000 should be ordered as DOT/HS-800 000.

1/0 ACCIDENTS**1/1 Emergency Services****HS-009 195** Fld. 1/1**PENNSYLVANIA'S HELICOPTER AMBULANCE STUDY**

by Robert R. Coleman

Published in *Highway Research Record* n272 p50-64 (1969)

Presented at the Highway Research Board 48th annual meeting.

The feasibility of using a helicopter as an ambulance is being studied in the Philadelphia suburban area. The basic premise was that delay in getting accident victims to proper medical aid could be caused by urban traffic congestion and travel distance in rural areas. The helicopter and its crew and equipment are described. During the study 38 victims were air-lifted from traffic accident scenes. Average time from receipt of alert to delivery of victim to the hospital was 20.9 minutes. Trip time from accident scene to hospital averaged 6.0 minutes. Reaction to the experiment has been favorable.

Search terms: Helicopter ambulances /Suburban areas; Helicopter ambulances /Travel time; Helicopter ambulances /Reaction time; Traffic delay minimization /Helicopter ambulances; Feasibility studies /Helicopter ambulances

1/3 Investigation and Records**HS-009 196** Fld. 1/3; 2/4; 1/4**RELATIONSHIP OF RURAL HIGHWAY GEOMETRY TO ACCIDENT RATES IN LOUISIANA**

by Olin K. Dart, Jr.; Lawrence Mann, Jr.

Published in *Highway Research Record* n312 p1-16 (1970)

The purpose of this project was (a) to

determine which geometric variables contribute most to accidents, and (b) to predict the accident potential of a certain section of Louisiana highways. This study involved approximately 1,000 miles of rural highways distributed evenly throughout Louisiana. The accident records investigated cover a 5-year period from 1962 to 1966. The variables studied in order to find their relation to accidents were percentage of trucks, traffic volume ratio, lane width, shoulder width, pavement cross slope, horizontal alignment, vertical alignment, percentage of continuous obstructions, marginal obstructions per mile, and traffic access points per mile. These 10 variables, their squares, and their first order interactions were used in a regression analysis to construct mathematical models to determine the contribution of the variables to total accidents, accidents on wet roads, accidents on dry roads, accidents during the day, accidents during the night, total injuries, and total fatalities. One mathematical model shows that a total of approximately 46 percent of all accidents are explained by the 10 variables included in this study. The variables not investigated — involving the driver, the vehicle, and other geometrics — account for the remainder of the variation in total accidents. Based on their interaction with traffic volume, the 2 geometric variables having the most important effect on accident rates are pavement cross slope and traffic conflicts. The remaining geometric variables studied in order of decreasing effect on accident rates are lane width, horizontal alignment, and shoulder width.

Search terms: Accident factors /Traffic data analysis; Accident factors /Highway design; Accident risk forecasting /Variables; Accident research /Variables; Accident research /Mathematical models; Traffic conflicts /Accident factors; Slopes /Accident factors; Accident research /Louisiana; Accident research /Reviews

HS-009 197 Fld. 1/3**MOTOR VEHICLE SAFETY: THE SYSTEM**

by W. F. Campbell

National Research Council of Canada

May 1968 35p 17 refs

Report no. TN-1

The literature with selected statistics is reviewed in relation to accident causes, prediction and prevention. It is concluded that a great deal more information on the circumstances surrounding the occurrence of motor vehicle accidents is required before any real understanding of the phenomenon is achieved.

Search terms: Accident statistics /Canada; Accident analysis /Reviews; Accident risk forecasting; Fatalities /Canada; Accident types; Accident factors /Weather; Weather /Fatalities; Road conditions /Accident factors; Rural accidents; Urban accidents; Driver behavior; Age factors in accidents; Males /Accident statistics; Females /Accident statistics; Driver physical fitness /Accident factors; Defective vehicles /Accident factors; Vehicle inspection /Defects; Traffic control /Accident factors; Driver licensing /Accident factors

HS-009 198 Fld. 1/3; 5/20**LEGION WAREHOUSE CORP. AND TRI-STATE TRANSPORTATION, INC. ACCIDENT OF FEB. 6, 1970, MIDDLETOWN, CONN.**

Bureau of Motor Carrier Safety

30 Jun 1970 10p

Report no. 70-2

One fatality, injuries to one, and approximately \$10,000 property damage resulted from a rear end collision involving two trucks. Accident was attributed to inattention and following too closely in case of one driver and poor maintenance in case of the other.

Search terms: Truck accidents; Accident factors /Attention; Accident factors /Maintenance; Accident fac-

HIGHWAY SAFETY

HSL NO. 71-19

1/3 Investigation and Records (Cont'd.)

HS-009 198 (Cont'd.)

tors /Tailgating; Accident case reports; Injuries /Truck accidents; Fatalities /Truck accidents; Property damage accidents

1/4 Locations

HS-009 199 Fld. 1/4; 2/4

THE DIAGNOSTIC TEAM APPROACH TO RAIL-HIGHWAY GRADE CROSSING SAFETY EVALUATION

by Hoy A. Richards; Neilon J. Rowan; Ernest W. Kanak

Published in *Highway Research Record* n272 p1-13 (1969)

Presented at Highway Research Board 48th annual meeting.

This paper describes the diagnostic study technique as it is applied by the medical profession and relates the applicability of this approach to rail-highway grade crossing safety evaluation. In general, the diagnostic team has proven to be a successful procedure in identifying and isolating factors that contribute to unsafe conditions at grade crossings, preparing of priorities for crossing protection, recommending improvements in protective equipment, developing on-the-spot improvement programs, establishing an interdisciplinary approach to the solution of a common problem, and establishing a line of communication between groups and individuals who are responsible for the safe operation of rail-highway grade crossings. The results of a diagnostic team approach in a cooperative project between the Bureau of Public Roads and the Texas Highway Department are described.

Search terms: Railroad grade crossings /Accident location; Railroad grade crossings /Multidisciplinary teams; Multidisciplinary teams /Accident location; Railroad grade crossings /

Safety devices; Spot improvement program /Railroad grade crossings; Accident risks /Railroad grade crossings

HS-009 200 Fld. 1/4

THE NODAL METHOD OF COLLISION LOCATION

by Murray D. Segal; Roger L. Mallar

Published in *Highway Research Record* n272 p39-49 (1969)

Presented at the Highway Research Board 48th annual meeting.

During the past two years the Maine State Highway Commission has developed an accident location system based on network principles widely used in the highway planning field. The development of the system is described, beginning with a review of alternative methods available and ending with an evaluation of the initial results as applied to the 4,600 miles of federal-aid and state highways. This initial experience with the node-link method of accident location suggests that it is an economical and flexible tool that has greatly enhanced the capability of the engineering staff to utilize factual data in the safety program. The system uses 20,000 numbered markers.

Search terms: Accident location / Highway coding; Mileposts /Accident location; Node positions /Accident location; Node positions /Highway coding; Highway coding /Maine

HS-009 201 Fld. 1/4; 2/9; 1/3

PROBABILITY STUDY OF HIGH ACCIDENT LOCATIONS IN KANSAS CITY, MISSOURI

by William L. Smith

Published in *Traffic Engineering* v40 n7 p42-9 (Apr 1970)

The goal of this study was to provide a

relevant analysis of hazardous intersections. To accomplish this goal, this study was developed with the use of probability theory and a series of input-output systems. A secondary goal was the development of easily used nomographs for the determination of intersection accident probability and statistical analysis of the effects of intersection improvements on the accident probability. Through the development of easily used nomographs, it is hoped that this study technique can be more easily made a part of a continuing network accident analysis.

Search terms: Intersections /Accident analysis; Intersection collisions /Probability theory; Intersection collisions /Nomographs; Highway improvements /Accident risk forecasting; Information systems /Accident research

2/0 HIGHWAY SAFETY

2/4 Communications

HS-009 202 Fld. 2/4; 1/4; 4/7

EVALUATION OF RAIL- HIGHWAY GRADE CROSSING PROTECTION IN RURAL AREAS

by T. G. Schultz; W. D. Berg; J. C. Oppenlander

Published in *Highway Research Record* n272 p14-23 (1969)

12 refs

The purposes of this study were to analyze the effects of environment, geometric characteristics, and highway and railroad traffic patterns with respect to grade crossing accidents in rural areas, and to develop warrants for protective devices at rural grade crossings. Comparison was made of 289 grade crossings that had experienced one or more accidents and 241 randomly selected non-accident grade crossings. Regression analysis was used to develop a model for predicting relative hazard for the sample locations. Relative hazard was expressed as a func-

tion of average daily highway traffic, average daily train traffic, roadside distractions, pavement width, and number of tracks. Modification of the model permitted development of warrants for selecting the recommended type of protective device for crossings in rural areas. These warrants are predicted on protection levels currently employed at crossings in Indiana.

Search terms: Railroad grade crossings/Rural areas; Railroad grade crossings/Safety devices; Railroad grade crossing accidents/Regression analysis; Railroad grade crossings/Accident location; Nomographs/Railroad grade crossings; Accident risk forecasting/Railroad grade crossings; Traffic flow/Railroad grade crossing accidents; Environmental factors/Railroad grade crossing accidents; Warrants/Safety devices; Railroad grade crossings/Indiana

HS-009 203 Fld. 2/4; 3/4; 3/12; 4/7

A SAFETY EVALUATION OF CURRENT DESIGN CRITERIA FOR STOPPING SIGHT DISTANCE

by John C. Glennon

Published in *Highway Research Record* n312 p33-54 (1970)

18 refs

This paper presents a review of the current American Association of State Highway Officials design standards and an evaluation of these standards based on existing practices. The evaluation considered the criteria that were employed in developing the standards and that include driver perception — reaction time, design friction factors, assumed speeds for design, driver's eye height, and object height. In addition, the report proposes a new philosophy for sight distance design, a philosophy that considers the visual requirements

for safety depending on operational conditions.

Search terms: Stopping distance; Safety design; Sight distances; Driver reaction time; Perception; Eye location; Braking distances; Braking time; Friction studies; Speed studies; Mathematical analysis; Wet road conditions; Dry road conditions

HS-009 204 Fld. 2/4; 1/3

ACCIDENTS AT MEDIAN CROSSOVERS

by G. R. Garner

Published in *Highway Research Record* n312 p55-63 (1970)

5 refs

The purpose of this study was to examine the necessity for and the value of median crossovers on limited-access facilities. An accident analysis provided information on the frequency and nature of accidents at median crossovers. The type of and necessity for crossover usage by authorized personnel was determined from interviews with highway maintenance engineers and questionnaires completed by state police who patrol limited-access facilities. It was found that crossovers do cause frequent accidents in some locations, thus negating the positive benefits of having crossovers. Undesirable locations for crossovers include urban areas, interchange areas, and any location where use by the general public is likely. Applying more stringent controls to the location and use of median crossovers than now employed may result in a 5 percent reduction in accidents on limited-access facilities.

Search terms: Median crossover collisions

HS-009 205 Fld. 2/4; 1/3

RELATIONSHIP BETWEEN CURVATURE AND ACCIDENT

EXPERIENCE ON LOOP AND OUTER CONNECTION RAMPS

by John G. Yates

Published in *Highway Research Record* n312 p64-75 (1970)

refs

This paper examines the relationship between accident rate and curvature on loop and outer connection ramps of the Interstate Highway System. Ramp characteristics considered include maximum curvature, location of ramp, enter or exit direction with respect to the main-line unit, and average daily traffic. Accidents per million vehicles are used as the primary indication of accident experience. Results of the investigation indicate that accident rates increase with maximum curvature for all right entering or exiting loops and outer connections except rural loops. Accident rates are lower on right entering or exiting outer connections with no curvature (less than 1 deg) than on those with curvature for all but one urban ADT category. All urban right entering or exiting loops and outer connections, except urban loops, show a positive correlation between ADT and accident rate. The effect of traffic volume on rural ramp safety for various curvatures exhibited mixed relationships.

Search terms: Accident rates; Curvature; Ramps; Traffic volume; Safety design

HS-009 206 Fld. 2/4; 5/20; 1/3

AN EVALUATION OF DESIGN CRITERIA FOR OPERATING TRUCKS SAFELY ON GRADES

by John C. Glennon

Published in *Highway Research Record* n312 p93-112 (1970)

14 refs

This paper is concerned with the evalua-

1/4 Communications (Cont'd.)

HS-009 206 (Cont'd.)

ation of design criteria relating truck operating characteristics on grades to the implementation of truck climbing lanes. The evaluation is specifically concerned with truck operating characteristics on grades, truck weight-horsepower ratios as they pertain to truck operating characteristics, and truck speed as it is related to truck operating characteristics and design criteria for climbing lanes.

Search terms: Truck performance; Climbing lanes; Road grades; Truck power; Truck lanes; Accident rates; Weight to power ratio; Velocity

HS-009 207 Fld. 2/4; 2/9

LET'S MAKE ALL HIGHWAYS ONE-DIRECTION AND ELIMINATE THE HEAD-ON CRASH

by Horace E. Campbell

Published in *Traffic Safety* v70 n4 p16-7 (Apr 1970)

Dual highways with 200 feet of flat traversable land between the opposing traffic lanes, and 100 feet of flat traversable land as deceleration lanes on the right are recommended. For roads already built, one way roads at optimum intervals are urged. An accident case in which a wider median strip would have prevented death and injury is cited.

Search terms: One way traffic / Roads; Median width / Accident prevention; Divided highways / Median width; Deceleration lanes / Accident prevention; Accident case reports / Median width

2/5 Lighting

HS-009 208 Fld. 2/5; 1/3; 2/4

RELATIONSHIP BETWEEN LIGHTING AND ACCIDENT EX-

PERIENCE BETWEEN INTERCHANGES

by John G. Yates; Richard L. Beatty

Published in *Highway Research Record* n312 p85-92 (1970)

refs

This paper examines the relationship between accident experience and lighting between interchanges of the Interstate Highway System in urban areas. Characteristics considered include existence of lighting, number of lanes, intensity of lighting, and average daily traffic volume. Accidents per hundred million vehicle-miles of travel are used as the primary indicator of accident experience. Results indicate that 24-hour accident rates and night (6 p.m. to 4 a.m.) accident rates are higher on lighted highways than on unlighted highways regardless of whether mainline units are classed by number of lanes or by ADT levels. Averages of various geometric, traffic, and accident characteristics for lighted and for unlighted units were compared and discrepancies noted. There is no discernible relationship between lighting intensity and accident rate on 2-lane mainline units or 3-lane mainline units.

Search terms: Accident rates; Interstate highway system; Lighting design; Highway lighting

HS-009 209 Fld. 2/5; 1/3

ROADWAY LIGHTING

by William L. Williams

Published in *Traffic Engineering* v40 n6 p30-4 (Mar 1970)

17 refs

Controversy continues over the safety benefits of highway lighting. Only a few statistically controlled studies have been made, but it appears that the safety benefit/cost ratio for continuous roadway lighting is either nonexistent or very

small. Furthermore, 35% of the fixed objects involved in fatal collisions are light supports. However, benefits of spot lighting are well documented. A California study found night accident rates reduced by spot lighting as follows: 65% at intersections, 52% at railroad crossings having poor alignment, and 28% at bridge approaches with poor alignment. This is a typical example. In a British study of 64 lengths of road, the frequency of injury accidents in darkness decreased by 30% after introduction of better lighting. Pedestrians seem to derive more benefit from improved lighting than other road users. Studies in Sydney, Australia and Kansas City showed that increased illumination leads to decreased night accident rates. The Highway Research Board has received proposals for further research.

Search terms: Highway lighting / Accident rates; Highway lighting / Accident prevention; Accident location / Highway lighting; Street lighting / Accident rates; Street lighting / Accident prevention; Street lighting / Pedestrian injuries; Street lighting / Injury prevention; Highway lighting / Injury prevention; Day vs night accidents / Statistics; Accident rates / Statistics

2/9 Traffic Control

HS-009 210 Fld. 2/9; 1/3

THE RELATIONSHIP OF ACCIDENTS TO LENGTH OF SPEED-CHANGE LANES AND WEAVING AREAS ON INTERSTATE HIGHWAYS

by Julie Anna Cirillo

Published in *Highway Research Record* n312 p17-32 (1970)

Results of this analysis indicate that increasing the length of weaving areas will decrease the accident rate. Accident rates on individual speed-change lanes exhibited a similar relationship with length. The effect of increasing the length of acceleration lanes appears to be

substantial when the percentage of merging traffic is above 6 percent. The effect of increasing the length of deceleration lanes is not as great. Thus the relative benefit (i.e., savings in terms of lower accident rates) is greater from longer acceleration lanes than from longer deceleration lanes. For a given length of acceleration or deceleration lane, the accident rate increases respectively as the percentage of merging or diverging traffic increases.

Search terms: Speed changes; Accident rates; Lane changing accidents; Weaving; Interstate highway system; Weaving capacity; Acceleration lanes; Deceleration lanes

HS-009 211 Fld. 2/9

PASSING PERFORMANCE WITH IN-CAR DISPLAYS

by Edward F. Rizy; Martin Sonn; Donald B. Hampton

Published in *Highway Research Record* n312 p113-124 (1970)

9 refs

Passing Aid System II (PAS II), a traffic monitoring system currently under development, is designed to advise drivers on 2-lane roads whether it is safe to pass in a sight-limited situation. The present study compares the effects of alternate PAS II in-car displays on driver performance in a highway driving simulator. The 3 displays tested were an alphameric readout, a flashing-color indicator, and an auditory signaling system; all 3 displays indicated the time before an oncoming car would be met. The alphameric display was related to consistent and conservative passing under normal circumstances. Drivers did not respond to emergency situations as well with the alphameric as with the flashing display. The auditory display, with a repetitive rate of sound, was confusing to drivers. Drivers preferred the alphameric display and rated the auditory low. Based on both throughput and safety maximization, the flashing display

was recommended.

Search terms: Passing aid systems; Two lane roads; Two way traffic; Accidents; Decision making; Reaction time; Passing; Audio display systems; In car displays; Display systems; Flashing warning signals

HS-009 212 Fld. 2/9; 1/3; 4/5

"PLOTTER" UNLOCKS POTENTIAL OF COMPUTERIZED INFORMATION

by Peter G. Barkley

Published in *Traffic Safety* v70 n4 p12-3, 38 (Apr 1970)

Computer applications for accident records and traffic analysis are described. The plotter is capable of producing maps, histograms, and graphs.

Search terms: Accident records /Plotters; Traffic data analysis /Plotters; Plotters /Graphs; Plotters /Maps; Plotters /Histograms; Plotters /Computers

HS-009 213 Fld. 2/9

SPEED AND SPEED CONTROL

by Donald E. Cleveland

Michigan Univ. Highway Safety Research Inst.

1970 15p 162 refs

Ch. 6 of *Traffic Control and Roadway Elements - Their Relationship to Highway Safety Revised*.

Minimum accident involvement is found at average speeds, rather than either high or low speeds, but single vehicle non-collision accidents increase exponentially with speed. However, U.S. studies show no strong evidence that speed control on urban or rural highways has the potential for significant accident reduction. European studies show that speed control can reduce both accident rate and severity of

accidents. Recent studies indicate that a change in speed distribution from non-normal to normal, statistically produces a significant accident reduction. Before the benefits of speed control can be determined, the effects of enforcement on safety must be understood. Although there are indications that police law enforcement can reduce accidents, information which would define the amount of enforcement needed and its effect on accidents, is not presently available.

Search terms: Speed /Accident factors; Speed limits /Europe; Single vehicle accidents /Speed; Accident severity /Speed; Injury severity /Speed; Accident types /Speed; Speed limits /Accident prevention; Speed limits /Speed; Speed limits /United States; Speed limits /Law enforcement

HS-009 214 Fld. 2/9

THE CONTRIBUTION OF ROAD MARKINGS TO HIGHWAY SAFETY

by A. H. Kennard

Published in *Road International* n75 p46-50 (Dec 1969)

Presented at the African Highway Conference, Addis Ababa, Ethiopia.

Accident statistics for Great Britain have been studied to determine where road markings can and should be used for accident prevention. Accidents have been divided into categories for pedestrians, motorcycles and mopeds, vehicle occupants, urban, and rural. Road markings are discussed in relation to these types of accidents.

Search terms: Pavement markings /Accident prevention; Accident statistics /Great Britain; Pedestrian accidents /Accident prevention; Motorcycle accidents /Accident prevention; Urban accidents /Accident prevention; Rural accidents /Accident prevention; Vehicle accidents /Accident prevention; Lane markings /Acci-

HUMAN FACTORS

HSL No. 71-19

2/9 Traffic Control (Cont'd.)

HS-009 214 (Cont'd.)

dent prevention; Pavement edge markings / Accident prevention; Mopeds / Accident prevention; Pavement markings / Highway safety

3/0 HUMAN FACTORS

3/2 Anthropomorphic Data

HS-009 215 Fld. 3/2; 5/4

A STUDY OF FORCES CAUSED BY HEAD IMPACT ON AIRCREW PERSONNEL ARMOR UNDER SIMULATED CRASH CONDITIONS

by Clifford I. Gatlin; James L. Schamadan; Edward R. Barron; Stanley D. Tanenholtz

Army Natick Labs.; Dynamic Science

Nov 1968 110p
Contract DAAG17-67-C-0138
Report no. AD-685 838; TR-69-49-CE; C & PLSEL-59

Results of a test program conducted to determine the magnitude, duration, and shape of the force-time relationship resulting from head impact on personnel armor in a crash situation are presented. The first task included modification of an armor front torso plate to carry the test instrumentation, modification of the anthropomorphic dummy to improve human simulation, and modification of an armored crew seat to prevent failure. The second task involved 12 dynamic tests using two types of armor, both with and without a protective helmet. Test results indicated that significant head-armor impact occurs most frequently in the chin area but that the loads would not be expected to produce serious injury to a human. Modifications in the armor are recommended to reduce the injury potential. No major seat failures occurred during the tests.

Search terms: Head impact toler-

ances / Impact tests; Head impact tolerances / Helmets; Impact sleds / Head impact tolerances; Anthropomorphic dummies / Head impact tolerances; Seat failures / Impact tests; Protective clothing / Head impact tolerances; Protective clothing / Head injuries; Loads (forces) / Head impact tolerances; Impact forces / Head impact tolerances; Impact forces / Time factors

AVAILABILITY: NTIS

3/4 Driver Behavior

HS-009 216 Fld. 3/4; 1/3

YOUNG DRIVERS AND ROAD ACCIDENTS

by Lars-Bruno Kritiz; Goran Nilsson

Sweden Statens Trafiksakerhetsrad

Nov 1967 18p 17 refs

A study of 8,997 Swedish drivers was made to determine to what extent the characteristics especially conditioned by age contribute to the overrepresentation of the 18-24 age group in road accidents. It was found that young male drivers are involved in more accidents than older drivers. Young female drivers show less difference in accident involvement than young male drivers. The observations suggest that the difference in accident involvement cannot be explained by differences in mileage, driving habits, or night driving. Other factors connected with age have contributed to the higher accident rate of young male drivers. These variables were not discovered in this study.

Search terms: Young adult drivers / Accident rates; Male drivers / Accident rates; Female drivers / Accident rates; Driver mileage / Accident rates; Night driving / Accident rates; Driver behavior / Accident rates; Driver behavior / Young adult drivers; Driver behavior research / Sweden

3/5 Driver Education

HS-009 217 Fld. 3/5; 2/8

RESEARCH, INSTRUCTION, PUBLICATIONS, SERVICES - FOUR PHASES OF SAFETY EDUCATION AT CENTRAL MISSOURI STATE

by Robert L. Marshall

Published in *Traffic Safety* v69 n12 p24-5, 37-8 (Dec 1969)

The Safety Center at Central Missouri State College offers programs in driver and safety education and in law enforcement for undergraduates and programs in safety education for graduate students. These programs are described, especially the one for training driver education teachers. The center also conducts safety research.

Search terms: Driver education / Instructors; Law enforcement; Safety research / Colleges; Safety education / Colleges; Colleges / Driver education

HS-009 218 Fld. 3/5

BEHIND-THE-WHEEL SELF ANALYSIS IN DRIVER REHABILITATION

by James Ray Adams

Continental Research Institute

7 Apr 1971 18p

Safe driving requires attentiveness and judgment on the part of the driver. These psychological characteristics are affected by many emotional and physical states of which a driver should be aware. A regimen is proposed for aiding the problem driver in learning how to learn about his own states of mind and how they affect his driving. This process of learning how to learn, sometimes called meta-learning, is in two phases: the driver takes a guide-sheet with him and carries out daily self-analysis of his driving performance, and then returns to a group where he discusses his observations. The seven emotional and physical states deal with anger and driving style; tired and hungry

states; getting home after drinking; nervousness and anxiety; sleepiness; worry and depression; excitement and joy. Four factors in driving style analyzed are overtaking; near misses; vulnerability; left turns.

Search terms: Driver behavior / Problem drivers; Driver rehabilitation / Problem drivers; Driver behavior / Psychological factors; Driver performance under stress; Learning rates; Discussion groups / Problem drivers; Driver fatigue / Problem drivers; Drinking drivers; Attention lapses / Problem drivers; Left turns / Problem drivers; Overtaking / Problem drivers; Risk taking / Problem drivers; Driver characteristics / Problem drivers; Emotions / Problem drivers; Anxiety / Problem drivers; Driver physical fitness / Problem drivers; Aggression / Problem drivers; Accident risks / Problem drivers

HS-009 219 Fld. 3/5

WHAT YOU SHOULD KNOW ABOUT DRIVING SCHOOLS

by Harris Edward Dark

Published in *Family Safety* v29 n1 p4-6 (Spring 1970)

Some examples of fraudulent driving schools are cited, with the observation that a fraudulent operation is also likely to be an unsafe one. However, most commercial driving schools are good and, while the course does not compare with a high school driver education course, they fill the need to learn to drive safely. Good training costs money, and a school that charges less than 10% than the local average is likely to be poor. Other tips on how to choose a school include: check credentials; don't be pressured into signing a contract for a specific number of lessons; don't fall for a guarantee that you will be able to pass the state driver's test and get a license; a school should have a maximum cut-off at about 25 hours of instruction; and the instructor should neither confuse you by teaching too fast, or by insisting on

unreasonable perfection in each point before proceeding to the next. The North American Professional Driver Education Association and its efforts to enforce good standards of instruction and ethics are mentioned.

Search terms: Commerical driving schools; Driver education; Driver education evaluation; Driver education costs; Instructor certification

3/6 Driver Licensing

HS-009 220 Fld. 3/6; 4/1

THE HIGH COST OF POOR DRIVER LICENSING

by Jim Winsor

Published in *Commercial Car Journal* v118 n4 p73-8 (Dec 1969)

The need for uniform commercial driver licensing in all the states is discussed. Differing laws for truck drivers, motorcycle operators, chauffeur's license, commercial buses, and school buses are mentioned. The "class license", as specified in the Uniform Vehicle Code, and if accepted by all the states, is seen as the solution to conflicting standards and requirements. How many classes, what each class includes, and gross vehicle weight limits for the classes are continuing problems. Motor Carrier Safety Regulations and their proposed changes are given. Comments on these regulations include: a point system be used as a basis for disqualifying a driver; periodic re-testing of drivers be required; minimum age be lowered to 18. Fleetmen are urged to support legislation favoring "one driver-one license" concept with the class system built in.

Search terms: Driver license standards / Truck drivers; Professional drivers / Licensing; School bus drivers / Licensing; Driver license standards / School bus drivers; Driver licensing / State laws; Driver tests; Classified driver licenses

HS-009 221 Fld. 3/6; 4/5

INPUT FOR BETTER DRIVING

Anonymous

Published in *Journal of American Insurance* v47 n1 p9-11 (Jan-Feb 1971)

The use of computer files in identifying stolen vehicles by license number and checking driver records is reported. Some systems are not yet operational. Planned computer uses include: a unique identification code marked in invisible fluorescent material between layers of safety glass on all new cars; automatic license plate scanning systems to detect stolen and illegally operated autos; and sensors buried in the roadway to detect speeders and activate traffic signals by detecting gaps in traffic. The National Driver Register's comprehensive data bank of individuals whose driver licenses have been suspended, revoked, or denied gives 24 hour service on 65,000 queries a day. The possibility of linking state computer systems with the National Driver Register is being investigated.

Search terms: Computerized theft checks / State action; Computerized driver records; National Driver Register; Electronic traffic control; Stolen vehicles; Theft prevention devices

3/11 Pedestrians

HS-009 222 Fld. 3/11

PEDESTRIAN SAFETY RESEARCH IN JAPAN

by Akira Watanabe

Published in *Experimental Safety Vehicles*, Washington, 1971, p63-70

7 refs

Pedestrians account for about 37% of the traffic accident fatalities in Japan, and this high rate is still increasing. Pedestrian safety research is discussed, including energy absorbing structures on

OTHER SAFETY-RELATED AREAS

3/11 Pedestrians (Cont'd.)

HS-009 222 (Cont'd.)

vehicles, study of accident statistics involving pedestrians, mathematical analysis of pedestrians, and study of pedestrian behavior.

Search terms: Pedestrian safety / Japan; Pedestrian fatalities / Accident rates; Pedestrian accidents / Japan; Pedestrian accidents / Accident statistics; Pedestrian behavior; Pedestrians / Mathematical models; Energy absorbing systems / Pedestrian safety

AVAILABILITY: In HS-820 157

3/12 Vision

HS-009 223 Fld. 3/12; 5/10; 5/4

THIRD SPECIFICATION DISCUSSION: OTHER ACCIDENT AVOIDANCE FACTORS (VISIBILITY, LIGHTING, CONTROLS, DISPLAYS)

by Toyotaro Yamada, Chairman

Published in *Experimental Safety Vehicles*, Washington, 1971, p131-38

A panel discussion.

Conference delegates from the U. S., Japan, Germany, France, and Italy discussed the experimental safety vehicle from the point of view of visibility and lighting.

Search terms: Safety cars / Visibility; Safety cars / Vehicle lighting; Experimental automobiles / Visibility; Experimental automobiles / Vehicle lighting; Display systems / Safety cars; Display systems / Experimental automobiles; Control equipment / Safety cars; Control equipment / Experimental automobiles; Specifications / Safety cars; Specifications / Experimental automobiles

AVAILABILITY: In HS-820 157

HS-009 224 Fld. 3/12; 2/4; 4/7

VISIBILITY PROBLEMS IN CREST VERTICAL CURVES

by M. Livneh; J. Prashker; J. Uzan

Published in *Highway Research Record* n312 p76-84 (1970)

refs

This analysis permits determination of the zone of overtaking visibility for a crest vertical curve in a 2-way 2-lane highway. The proposed marking (Figs. 4 and 5) comprises a warning line, equal in length to the passing sight distance, indicating nearness of a zone of reduced overtaking visibility. In this zone the driver is allowed to complete an overtaking move begun earlier but not allowed to attempt a new one once he has passed the initial point of the warning line in the right lane. Analysis of the results shows that the length of the no-overtaking zone increases with that of the curve, up to the maximum where overtaking is unrestricted. The conclusion is that, in order to reduce the no-overtaking zone where the design cannot be based on the passing sight distance, the curve should be as short as possible but still comply with the requirements of stopping sight distance and driving convenience.

Search terms: Visibility; Road curves; Sight distances; Stopping distance; Overtaking; Passing; No passing zones; Mathematical analysis; Two lane roads; Two way traffic; Road grades

4/0 OTHER SAFETY-RELATED AREAS

4/6 Insurance

HS-009 225 Fld. 4/6

ECONOMIC REGULATION OF INSURANCE IN THE UNITED STATES

by John G. Day; Howard B. Clark

HSL No. 71-19

Department of Transportation

Jul 1970 81p 231 refs

Department of Transportation Automobile Insurance and Compensation Study.

The history of insurance regulation and the question of state versus federal regulation of insurance are discussed.

Search terms: Insurance industry / History; Insurance industry / Federal control; Insurance industry / State laws

AVAILABILITY: GPO \$0.40

HS-009 226 Fld. 4/6

PRICE VARIABILITY IN THE AUTOMOBILE INSURANCE MARKET. ITS EXTENT, CAUSE AND RELATIONSHIPS TO "HIGH RISK" AND OTHER PROBLEMS

by Calvin H. Brainard; Stephen A. Carbine

Federal Trade Commission

Aug 1970 282p refs

Department of Transportation Automobile Insurance and Compensation Study.

This study is directed to the question of the high-risk market sector as a symptom of and a key to the fundamental problems affecting automobile insurers. The scope of inquiry is confined almost exclusively to the standard voluntary market because the inability of this market to absorb high risks is the cause of the high risk insurance problem. While physical damage insurance is an important cost element to auto insurance buyers, this study concentrates on the more significant and revealing liability lines and especially on bodily injury liability insurance. Price variability is held to be the crux of the problem.

JULY 2, 1971

Search terms: High risk drivers / Insurance rates; Insurance industry / Pricing; Liability insurance / Insurance rates; Liability insurance / High risk drivers; Injury compensation / Insurance rates; Injury compensation / Liability insurance

AVAILABILITY: GPO \$2.00

HS-009 227 Fld. 4/6; 1/2

ECONOMIC CONSEQUENCES OF AUTOMOBILE ACCIDENT INJURIES. PUBLIC ATTITUDES SUPPLEMENT

Department of Transportation

Sep 1970 48p

Department of Transportation Automobile Insurance and Compensation Study.

A survey of some of the basic attitudes of seriously injured automobile accident victims toward the existing automobile accident insurance system is presented. The attitudes of this group are compared to those of the general car-owning population. In about half the cases, the victim was satisfied with his auto insurance experience; the main reasons given for dissatisfaction were unethical conduct by the insurance company and high cost. Attitudes toward fault versus no-fault insurance were also surveyed. No-fault was favored without qualification by 39% of the seriously injured and 40% of the general public. There was considerable inconsistency in responses in the survey.

Search terms: Insurance costs / Attitudes; Insurance rates / Attitudes; Insurance industry / Attitudes; No fault insurance plan / Attitudes; Fault / Attitudes; Accident costs / Public opinion; Injury costs / Public opinion; Insurance industry / Public opinion; Injury severity / Insurance claims; Injury severity / Attitudes; Insurance industry / Ethics

AVAILABILITY: GPO \$0.30

HS-009 228 Fld. 4/6; 1/3

COMPENSATION FOR MOTOR VEHICLE ACCIDENT LOSSES IN THE METROPOLITAN AREA OF WASHINGTON, D. C.

by Merwyn A. Kraft

District of Columbia Dept. of Highways and Traffic

Dec 1970 79p

Department of Transportation Automobile Insurance and Compensation Study.

The purposes of this study were to determine the direct costs of motor vehicle accidents and incidents to registered vehicle owners and other persons residing in the Washington metropolitan area and to provide data on accident frequencies and costs related to pertinent variables of the highway, vehicle, and driver. Also to be determined were the main elements of direct accident costs and the portions of the total cost that apply to each element. The study provides information with which to judge specific urban traffic improvements from the standpoint of accident cost savings. The adequacy of compensation from insurance is examined.

Search terms: Accident costs / District of Columbia; Damage costs / District of Columbia; Accident rates / District of Columbia; Benefit cost analysis / Traffic management; Accident compensation / District of Columbia; Driver vehicle road interfaces / Accident factors; Injury compensation / District of Columbia; Accident compensation / Insurance; Injury compensation / Insurance; Accident costs / Maryland; Accident costs / Virginia; Accident compensation / Maryland; Accident compensation / Virginia; Injury compensation / Maryland; Injury compensation / Virginia

AVAILABILITY: GPO \$1.00

HS-009 229 Fld. 4/6

OTHER SAFETY-RELATED AREAS

THE PRICE AND AVAILABILITY OF AUTOMOBILE LIABILITY INSURANCE IN THE NON-STANDARD MARKET

by Douglas G. Olson; Frank G. Vukmanic

Federal Trade Commission

Jan 1971 123p

Department of Transportation Automobile Insurance and Compensation Study.

The purpose of this paper is to examine the price structure and the availability of auto liability insurance for nonstandard or high risk drivers. It is difficult to specify the precise point at which a driver is classified as high risk. There are significant differences in prices among high risk companies for the same insurance applicant. For several hypothetical applicants there was a price range of 200%. More important, the price comparisons included only those companies that would normally expect to receive similar applicants and were willing to provide insurance. Product differentiation in auto insurance is typically limited within geographic areas by the regulatory structure, especially for liability insurance. Failure of consumers to shop among alternative insurers may result in large alternative costs.

Search terms: Insurance industry / Pricing; Insurance rates / Liability insurance; Insurance rates / High risk drivers; Insurance denial / High risk drivers; Insurance industry / Statistics

AVAILABILITY: GPO \$1.25

HS-009 230 Fld. 4/6

MOTOR VEHICLE CRASH LOSSES AND THEIR COMPENSATION IN THE UNITED STATES. A REPORT TO THE CONGRESS AND THE PRESIDENT

by John A. Volpe

VEHICLE SAFETY

HSL No. 71-19

4/6 Insurance (Cont'd.)

HS-009 230 (Cont'd.)

Department of Transportation

Mar 1971 159p refs

Department of Transportation Automobile Insurance and Compensation Study.

An overview of the significance of motor vehicle accident compensation is presented. The present system for reparations, based on the fault principle, is discussed. The economic consequences of auto accidents and the effects of auto liability insurance on loss reduction are described. Alternatives to the present tort liability system are discussed, and recommendations for change are given.

Search terms: Accident compensation; Injury compensation; Insurance industry; Liability insurance /Loss reduction; Accident costs; Liability /Torts; Fault /Insurance; No fault insurance plan; Group insurance; Compulsory insurance; Insurance industry /Public opinion

AVAILABILITY: GPO \$0.65

5/0 VEHICLE SAFETY

HS-009 231 Fld. 5/0

MOTOR VEHICLE SAFETY — 1969. HEARING BEFORE THE COMMITTEE ON COMMERCE, APRIL 14-15, 1969

Congress. Senate Commerce Committee

1969 326p
Report no. Senate-Serial-91-17

91st Congress, 1st Sess., S. 1245.

The purpose of S. 1245 is to authorize appropriations for the fiscal years 1970 and 1971 to carry out the provisions of the National Traffic and Motor Vehicle Safety Act of 1966 and to amend the definition of "motor vehicle equipment"

in that act. Text of S. 1245 and comments on it are presented. Testimony on many aspects of vehicle safety is included.

Search terms: Appropriations /Vehicle safety; National Traffic and Motor Vehicle Safety Act of 1966; Safety devices /Vehicle safety; Federal laws /Appropriations; Safety laws /Appropriations

AVAILABILITY: GPO

5/1 Brake Systems

HS-009 232 Fld. 5/1

BRAKING DEVELOPMENTS

by Burghard

Published in *Experimental Safety Vehicles*, Washington, 1971, p50-2

The types of braking systems presently in use are discussed. One certain improvement would be a system which regulated each wheel independently, depending on the traction.

Search terms: Brake systems; Traction /Brake systems

AVAILABILITY: In HS-820 157

HS-009 233 Fld. 5/1

"TRIPLE-SAFE" AIR BRAKE SYSTEM: SERVICE, EMERGENCY, PARKING

by E. F. Beatty

Royal Industries

1971 6p
Report no. SAE-710211

Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

The term triple safe is used to identify an air brake system with three separate circuits, two of which are service brake systems of virtually equal effectiveness; the third is a spring parking brake system. The paper reviews the spring parking brake chamber capability and describes a triple-safe air brake system and chambers that have similar service and emergency capacities, and parking capabilities, to meet future requirements of trucks and buses.

Search terms: Emergency brakes /Air brakes; Brake systems /Air brakes; Brake chambers /Spring brakes; Spring brakes /Parking brakes; Triple diaphragm brake chambers; Brake maintenance; Vehicle control /Brake systems

AVAILABILITY: SAE

5/3 Cycles

HS-009 234 Fld. 5/3

STABILITY OF RAJDoot SCOOTER

by D. V. Singh; V. K. Goel

North Carolina A & T State Univ.; Roorkee Univ.

1971 11p 6 refs
Report no. SAE-710273

Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

Due to low first cost and economy in running and maintenance, two-wheeled vehicles, that is, scooters, are becoming very popular for urban transport in developing countries, particularly where the year-round climate is moderate. The present study was carried out at Roorkee in India as a theoretical investigation of the dynamic characteristics of the prototype of an indigenous scooter, Rajdoot, which is being developed by Escorts Ltd. The results are compared with the existing data for the Italian scooter Vespa.

Search terms: Motor scooter stability/Rajdoot; Motor scooters/Equations of motion; Motor scooters/Parameters; Motor scooters/Geometry; Motor scooters/Center of gravity; Rajdoot/Vespa

AVAILABILITY: SAE

HS-009 235 Fld. 5/3; 2/4

HAWKEYE AREA BIKEWAY SYSTEM. A PROPOSAL FROM THE BIKEWAY SUBCOMMITTEE OF PROJECT GREEN, A COMMITTEE OF CITIZENS FOR A BETTER IOWA CITY

Bicycle Inst. of America

Feb 1969 15p

Principles and plans for a proposed bikeway system are detailed. Route siting suggestions are listed. Construction and marking points are given, with illustrations of standard bicycle signs. Three specific routes are detailed with maps attached.

Search terms: Bikeways/Maps; Bikeway planning; Bikeways/Sign standards; Bikeways/Routing; Bikeways/Iowa City

HS-009 236 Fld. 5/3; 3/5; 1/3

MOTORCYCLE FACTS

National Safety Council

Published in *Accident Facts* 1969

Aug 1969 9p 17refs

Issued as a separate.

Statistics are presented for types of vehicles involved in accidents and resulting fatalities for 1968; for motorcycles and other motor vehicles involved in accidents and resulting fatalities for 1960-1968; for severity of motorcycle accidents; for types of motorcycle acci-

dents. Environmental factors; contributing circumstances, time factors, driver characteristics, injury types, protective apparel, and legislation are discussed. Motor scooter accidents also are included in the discussion.

Search terms: Accident statistics/Fatalities; Motorcycle accidents/Injury severity; Motorcycle accidents/Environmental factors; Motorcycle accidents/Time factors; Motorcycle accidents/Driver characteristics; Motorcycle accidents/Injuries; Motorcycle operator injuries; Motorcycle operator fatalities; Motorcycle passenger injuries; Motorcycle passenger fatalities; Motorcycle accidents/Protective clothing; Motorcycle laws; Motor scooter accidents

5/4 Design

HS-009 237 Fld. 5/4

POLYMETHACRYLATES FOR TOMORROW'S MULTIGRADE OILS?

by Ulrich Schodel

Rohm and Haas G. m. b. H.

1970 8p 5 refs
Report no. SAE-700054

Presented at Automotive Engineering Congress, Detroit, Mich., 12-16 Jan 1970.

Wear tests in a number of European gasoline and diesel engines and a study of deposit formation in Caterpillar 1 H and MS Sequence V B tests show that polymethacrylate viscosity index improvers in multigrade motor oils can lower wear levels below those predicted on the basis of oil viscosity, even under extreme operating conditions; new dispersant type polymethacrylates decrease deposit formation not only in MS Sequence V B but also in Caterpillar 1 H tests; and polymethacrylates should continue to play their important role in the formulation of multigrade motor oils.

Search terms: Multigrade oils/Poly-methacrylates; Multigrade oils/Viscosity; Multigrade oils/Wear tests; Bearings/Wear tests; Cylinders/Wear tests; Engine deposits/Inhibitors

AVAILABILITY: SAE

HS-009 238 Fld. 5/4

RUBBER WHEEL ABRASION TEST

by Frank Borik

Climax Molybdenum Co. of Michigan

1970 11p 13 refs
Report no. SAE-700687

Presented at Combined National Farm, Construction and Industrial Machinery and Powerplant Meetings, Milwaukee, Wis., 14-17 Sep 1970.

A laboratory test was developed to evaluate materials for their resistance to low-stress abrasion. The abrasion resistance was obtained by determining the volume loss of the specimen immersed in a silica sand slurry and wearing against a 7 in. diameter steel wheel, having a neoprene rubber rim, rotating at a speed of 240 rpm. The specimen is pressed against the wheel with a force of 50 lb. The wear test was used to determine and to compare the abrasion resistance of a variety of materials ranging from constructional steels to sintered carbides. The effects of test variables, metallurgical variables, and reproducibility of results are discussed. The test proved to be highly reproducible.

Search terms: Abrasion resistance/Materials tests; Abrasion resistance/Laboratory tests; Abrasives/Silica sand slurries; Abrasion tests/Steels; Abrasion tests/Sintered carbides; Abrasion tests/Plate glass; Neoprenes/Hardness; Neoprenes/Abrasion tests; Alloys/Abrasion tests

AVAILABILITY: SAE

HS-009 239 Fld. 5/4

METALLURGICAL INSTABILITY AND RESIDUAL STRESSES IN HARDENED STEEL

by E. B. Evans

Florida State Univ.

1971 7p 10 refs
Report no. SAE-710278

Presented at X-ray Fatigue Division, SAE Fatigue Design and Evaluation Committee, Ann Arbor, Mich., 24-25 Sept 1968.

All hardened steels in the as-quenched condition are metallurgically unstable, i.e., the amounts and compositions of the various phases present can be changed by thermal, mechanical, and environmental means. Six factors — cold treatment, tempering, aging, austenite reversion, environment (radiation), plastic deformation — are reviewed as to their influence on the metallurgical instability of hardened steel as revealed by changes in macro residual stresses and retained austenite content.

Search terms: Steels/Quenching; Steels/Austenite; Steels/Stability; Steels/Aging; Steels/Cold; Steels/Irradiation; Steels/Deformation; Steels/Stress (Mechanics); Steels/Tempering; Steels/Fatigue (Materials)

AVAILABILITY: SAE

HS-009 240 Fld. 5/4

THE GERMAN EXPERIMENTAL SAFETY VEHICLE PROGRAM

by Gunther Brenken

Published in *Experimental Safety Vehicles*, Washington, 1971, p47-9

The German automobile industry is working to develop an experimental safety car weighing about 2,000 pounds, a vehicle smaller than the one being

developed in the United States. Characteristics of the German vehicle are described.

Search terms: Safety cars/West Germany; Experimental automobiles/West Germany; Vehicle weight/Safety cars; Vehicle weight/Experimental automobiles

AVAILABILITY: In HS-820 157

HS-009 241 Fld. 5/4

CRASH TESTING

by Kraft

Published in *Experimental Safety Vehicles*, Washington, 1971, p53-4

Crash testing for the German experimental safety car is briefly discussed, particularly the static tests for reinforced doors.

Search terms: Safety cars/Doors; Doors/Impact tests; Doors/Static tests; Experimental automobiles/Doors

AVAILABILITY: In HS-820 157

HS-009 242 Fld. 5/4

THE FRENCH ESV PROGRAM

by Frybourg

Published in *Experimental Safety Vehicles*, Washington, 1971, p71-4

The objectives and problems in the experimental safety vehicle program are discussed, and its place in the French highway safety program is outlined.

Search terms: Experimental automobiles/France; Safety cars/France; Highway safety programs/France

AVAILABILITY: In HS-820 157

HS-009 243 Fld. 5/4

THE IMPORTANCE OF VEHICLE AGGRESSIVENESS IN THE CASE OF A TRANSVERSAL IMPACT

by Chillon

Published in *Experimental Safety Vehicles*, Washington, 1971, p81-4

Aggressiveness is defined as the action of a vehicle toward persons outside it in the event of an accident. Side impact tests are described, and a model is devised to explain this behavior and specify the roles of the various parameters intervening in the penetration of the struck vehicle. Reduction in aggressiveness of the front structure is a problem directly concerned with safety and repair costs as well as with the protection of passengers and pedestrians.

Search terms: Side impact collisions/Impact tests; Front structures/Crashworthiness; Automobile repair costs/Front structures; Pedestrian safety/Front structures; Occupant protection/Front structures; Mathematical models/Side impact collisions

AVAILABILITY: In HS-820 157

HS-009 244 Fld. 5/4

THE ITALIAN APPROACH TO VEHICLE SAFETY

by Giacomo Pocci

Published in *Experimental Safety Vehicles*, Washington, 1971, p85-6

The safety car program in Italy is briefly outlined. It will be applied to cars smaller than the American safety car.

Search terms: Safety cars/Italy; Vehicle safety/Safety cars; Vehicle size/Safety cars

AVAILABILITY: In HS-820 157

JULY 2, 1971

VEHICLE SAFETY

HS-009 245 Fld. 5/4

SOME CONSIDERATIONS ON THE CAR SAFETY PROGRAM

by Margara

Published in *Experimental Safety Vehicles*, Washington, 1971, p87-92

Italy has chosen an approach based on the study of subsystems rather than the American approach to safety cars. The reason for this decision is that two out of three Italian cars are small, and even by 1980 half of the cars in Italy are still expected to be small. The advantages of a subsystem approach are discussed. The size composition of cars in the various European countries is given in graphs.

Search terms: Vehicle size /European vehicles; Safety cars /Italy; Compact automobiles /Italy

AVAILABILITY: In HS-820 157

HS-009 246 Fld. 5/4

A SUBSYSTEM AND COMPONENT APPROACH TO VEHICLE SAFETY

Anonymous

Published in *Experimental Safety Vehicles*, Washington, 1971, p96-7

Italian proposals for the development of the experimental safety car program are outlined. Thirteen aspects of design are chosen for attention. The aim is incorporation of solutions to these problems in one car.

Search terms: Safety cars /Automobile design; Experimental automobiles /Safety design; Automobile design /Italy; Safety cars /Italy; Experimental automobiles /Italy

AVAILABILITY: In HS-820 157

HS-009 247 Fld. 5/4

INVESTIGATIONS RELATED TO THE DESIGN OF SAFER VEHICLES

by R. D. Lister

Published in *Experimental Safety Vehicles*, Washington, 1971, p99-106

Experimental work of the British Road Research Laboratory on the design of safer vehicles is discussed. Cost effectiveness studies, passive seat belts which work automatically when the door is closed, injury investigations, and side impacts are discussed.

Search terms: Side impact collisions; Vehicle safety /Vehicle design; Passive restraint systems /Seat belts; Injury research; Benefit cost analysis /Safety design; Door systems /Seat belt design; Vehicle design /Great Britain; Safety research /Great Britain

AVAILABILITY: In HS-820 157

HS-009 248 Fld. 5/4

SECOND SPECIFICATION DISCUSSION: CRASH WORTHINESS

by Albert Slechter, Chairman

Published in *Experimental Safety Vehicles*, Washington, 1971, p119-30

A panel discussion.

Conference delegates from the U. S., Great Britain, Japan, Germany, and France discussed crashworthiness of the experimental safety vehicle. Aspects included are bumper standards, impact tolerances, energy absorption, restraint systems, and interior design.

Search terms: Safety cars /Crashworthiness; Experimental automobiles /Crashworthiness; Bumper standards /Crashworthiness; Impact tolerances /Crashworthiness; Energy absorption /Crashworthiness; Restraint systems /Crashworthiness; Automobile interior design /Crashworthiness

AVAILABILITY: In HS-820 157

5/6 Fuel Systems

HS-009 249 Fld. 5/6

POLLUTION, EMISSIONS, ECOLOGY AND YOUR CAR

by Charles Goodacre

Published in *Autocar* v132 n3865 p2-4 (12 Mar 1970)

It is claimed that exhaust emissions from motor cars in normal domestic service do no harm to anyone. Exhaust emissions of carbon monoxide and hydrocarbons, crankcase emissions, static emissions from the car after it stops hot, and evaporative emissions are briefly discussed together with the devices developed to control them. It is claimed that expensive solutions are being developed for problems which do not exist.

Search terms: Air pollution emission factors; Carbon monoxide /Exhaust emissions; Hydrocarbons /Exhaust emissions; Crankcase emissions; Evaporative emissions; Exhaust emissions; Exhaust emission control devices

HS-009 250 Fld. 5/6

NATIONAL EMISSION STANDARDS FOR STATIONARY SOURCES

by Arthur C. Stern

Published in *Journal of Air Pollution Control Association* v20 n8 p524-8 (Aug 1970)

5 refs

Presented at the 63rd annual meeting of the Air Pollution Control Association, St. Louis, Mo., 14-18 June 1970.

The aspects of centralized or de-

5/6 Fuel Systems (Cont'd.)

HS-009 250 (Cont'd.)

centralized authority in emission control are discussed.

Search terms: Air quality standards / Federal role; Air quality standards / Local government; Emission standards

HS-009 251 Fld. 5/6

FEDERAL MOTOR VEHICLE EMISSION GOALS FOR CO, HC AND NOX BASED ON DESIRED AIR QUALITY LEVELS

by Delbert S. Barth

Published in *Journal of Air Pollution Control Association* v20 n8 p519-23 (Aug 1970)

19 refs

Presented at the 63rd annual meeting of the Air Pollution Control Association, St. Louis, Mo., 14-18 June 1970.

The historical background of the development of Federal mobile emissions standards has been presented. Based on issued and planned criteria documents, desired air quality goals for health protection have been set. The complexities inherent in the control of photochemical oxidants have been discussed and a control strategy involving joint control of hydrocarbons and nitrogen dioxides adopted. Using a modified roll-back calculation with a 1967 baseline, the following 1980 total motor vehicle emission goals by which to achieve desired air quality goals have been derived: CO 6.16 g/mi; Hydrocarbons 0.14 g/mi; NO_x 0.40 g/mi. The calculation of future motor vehicle emission goals should be a continuous process with new data being used as they become available.

Search terms: Emission standards / History; Smog control; Carbon monoxide; Hydrocarbons; Nitrogen oxides; Air quality standards

HS-009 252 Fld. 5/6

EXHAUST POLLUTION CONTROL. METHODS OF REDUCTION.

by G. G. Lucas; E. H. James; R. Chrast

Published in *Automotive Design Engineering* v9 p28-33 (Mar 1970)

19 refs

Design series on engine combustion. Pt. 2

Devices used to reduce hydrocarbons and carbon monoxide can be subdivided into two basic groups: those which attempt to treat these pollutants after their discharge from the engine cylinder and those which attempt to control the concentration levels leaving the cylinder. The first group uses three types of devices to achieve the required emission reduction: air injection into the exhaust ports, catalysts, and afterburners. Each of these is described. Systems which involve alternations to the induction system are also discussed. Fuel injection in stratified charge engines is described.

Search terms: Exhaust emission control devices / Hydrocarbons; Exhaust emission control devices / Carbon monoxide; Exhaust emission control devices / Air injection; Exhaust emission control devices / Catalysts; Exhaust emission control devices / Afterburners; Fuel injection / Stratified charge engines

HS-009 253 Fld. 5/6

VANISHING VEHICLE EMISSIONS

Anonymous

Published in *Automotive Information* v7 n1 p2-5 (Mar 1970)

Auto makers have achieved major gains in the battle against air pollution. Hydrocarbon emissions have been reduced by about two-thirds and carbon monoxide

emissions by about 65% since 1960. Major thrusts are now being made to control oxides of nitrogen, the other key ingredient in smog formation. Various exhaust control devices and techniques are discussed.

Search terms: Exhaust emission control devices; Hydrocarbons / Exhaust emission control; Carbon monoxide / Exhaust emission control; Nitrogen oxides / Exhaust emission control; Smog / Exhaust emissions; Air pollution control

HS-009 254 Fld. 5/6

LP GAS CONVERSION

by R. H. Eshelman

Published in *Automotive Industries* v142 n10 p59-62 (15 May 1970)

Conversions of late model, emission-controlled gasoline engines run about 50% lower on hydrocarbons, 60% lower on carbon monoxide, and about 50% lower in oxides of nitrogen. Potential for engines designed specifically for L-P operation and optimizing of emission control should meet any presently envisioned requirements. A wider range of uses for farm and industrial tractors and stationary power units based on a combination of cleaner operation, better serviceability, and performance is envisioned.

Search terms: Liquefied petroleum gases / Emission control; Hydrocarbons; Carbon monoxide; Nitrogen oxides

HS-009 255 Fld. 5/6

CATALYTIC CONVERTER MAY COST \$300

by Joseph M. Callahan

Published in *Automotive Industries* v142 n10 p22-4, 112 (15 May 1970)

Catalytic converters probably will be

additional one or two muffler-like devices to the exhaust systems that will add up to \$300 to the car cost, require replacement periodically, and have a few unavoidable other drawbacks.

Search terms: Catalytic converters / Costs

HS-009 256 Fld. 5/6

SOME EFFECTS OF EXHAUST GAS RECIRCULATION UPON AUTOMOTIVE ENGINE INTAKE SYSTEM DEPOSITS AND CRANKCASE LUBRICANT PERFORMANCE

by A. F. Gerber; R. G. Smith, Jr.

Cities Service Oil Co.

1971 7p
Report no. SAE-710142

Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

The following conclusions can be drawn from the results of this investigation of exhaust gas recirculation: 1. EGR at the 8.5% level reduced NO_x emission levels by approximately 65%; 2. intake valve and intake manifold deposits increased with EGR; 3. exhaust valve and intake port deposit levels were not affected by EGR; 4. EGR through the carburetor air intake caused a rapid accumulation of heavy deposits. The use of an effective carburetor detergent showed no beneficial results; 5. low-temperature sludge deposit formation was approximately 20% more severe with 10% EGR; 6. low-temperature sludge deposition increased with increased EGR rate; 7. low-temperature varnish formation was not affected by 10% EGR; 8. compression ring sticking in low-temperature operation was reduced by EGR; 9. Cu/Pb bearing corrosion was not affected by EGR; 10. High-temperature oil oxidation was reduced by approximately 13% with 10% EGR.

Search terms: Exhaust gas recirculation; Nitrogen oxides; Intake systems /

Deposition; Manifolds /Deposition; Sludge; Crankcase /Lubricants; Carburetors /Deposition; Bearings /Corrosion

AVAILABILITY: SAE

HS-009 257 Fld. 5/6; 5/4

CYLINDER GAS COMPOSITION OF SMALL 2-STROKE CYCLE GASOLINE ENGINE

by Shunichi Ohigashi; Yoshisuke Mamamoto

Kyoto Univ.

1971 17p 5 refs
Report no. SAE-710143

Presented at Automotive Engineering Congress, Detroit, Mich., 11-15 Jan 1971.

In a 2-stroke cycle crankcase-scavenged gasoline engine, the compositions of cylinder gas and exhaust gas were investigated by analysis of the sampled gas extracted from the cylinder and exhaust pipe. As is well known, the combustion process taking place in a 2-stroke cycle gasoline engine has cycle-by-cycle variations. In this study, a new method controlling the operation of the sampling valve was applied, which enabled us to select cycles showing the same peak pressure and to extract a combustion gas produced by the similar combustion process. From these data the following were confirmed: 1. for estimating the composition of combustion gases, simple equations of combustion reactions are available; 2. the most reliable valves estimating the scavenging properties may be calculated from the change of O₂ concentrations of sampled gases before and after scavenging; 3. it is necessary to select the gas sampling cycle by the cylinder pressure, because the scavenging process is affected by the combustion process in the preceding cycle; 4. no remarkable uneven local composition is observed at the time of spark ignition.

Search terms: Cylinder gases /Two

stroke cycle engines; Exhaust emissions /Two stroke cycle engines; Gas sampling /Scavenging; Cyclic pressures /Gas sampling; Cylinder pressures /Gas sampling

AVAILABILITY: SAE

HS-009 258 Fld. 5/6

FORD'S NEW SMOG-FREE "CONCEPT" CARS

by Jan P. Norbye; Jim Dunne

Published in *Popular Science* v196 n4 p56-8, 132-3 (Apr 1970)

Ford's work in cooperation with the Inter Industry Emission Control program is described. A thermal reactor which meets the IIEC goals takes care of hydrocarbons and carbon monoxide. These elements are collected in the reactor and effectively burned. For proper reaction, a temperature of 1,600 - 1,700 degrees F must be maintained. Concurrent effects are loss in horsepower and increase in fuel consumption. Catalytic converters control emission levels by altering the chemical characteristics of the exhaust gases. Exact composition of the catalysts is being kept secret. When gas gets the full chemical treatment, power losses and fuel consumption rises occur. Effects of air, ammonia, and fuel injection are discussed. Ford's next step will no doubt be a combination of electronic fuel injection and the use of ammonia as an exhaust additive. The federal test cycle is explained.

Search terms: Ford Motor Co.; Smog control; Inter Industry Emission Control Program; Thermal reactors; Catalytic converters; Ammonia / Exhaust gas additives; Electronic fuel injection /Exhaust emissions; Exhaust emission tests /Federal role; Hydrocarbons; Carbon monoxide; Nitrogen oxides

5/9 Inspection

HS-009 259 Fld. 5/9

INSPECTING VEHICLES - HOW TO IDENTIFY FAULTS

VEHICLE SAFETY

5/9 Inspection (Cont'd.)
HS-009 259 Fld. 5/9

by Ron Cater

Published in *Commercial Motor* v131 n3364 p87-9 (6 Mar 1970)

Some specific check points and tell-tale signs of commercial vehicle faults are given, including: tire wear possibly indicating misalignment, excessive toeing in or toeing out, or worn king pin assemblies; oil seal failures possibly indicating loose driving flanges, faulty center bearing, perhaps a bent shaft; and rust streaks around wheel nuts, possibly indicating failure of wheel discs, studs or nuts. No special equipment other than a small crowbar and a handlamp is recommended. Inspectors should have a keen eye and more than average common sense. A short test run in the vehicle to be inspected, and an understanding of what work the vehicle does over what sort of a route, are further recommendations for effective inspection.

Search terms: Vehicle inspection; Commercial vehicles /Inspection; Commercial vehicles /Inspection procedures

5/10 Lighting Systems

HS-009 260 Fld. 5/10

ARE EXTRA DRIVING LIGHTS NECESSARY?

by Tom Tappett

Published in *Mechanix Illustrated* v67 n513 p92-4, 126-7

Pencil beam and fog lights are discussed in relation to state laws, bulbs, cost, mounting, fuses, and aiming.

Search terms: Fog lamps /State laws; Fog lamps /Costs; Quartz halogen headlamps /Costs; Auxiliary lamp mounting; Auxiliary lamps /Electric fuses; Headlamp aiming; Headlamp re-

gulations; Pencil beam front lamps / State laws

5/11 Maintenance and Repairs

HS-009 261 Fld. 5/11; 5/4

CARELESSNESS CAN KILL ENGINE BEARINGS

Anonymous

Published in *Motor* (New York) v132 n6 p46-7, 94 (Dec 1969)

The proper precautions, techniques and tools to be used in installing bearings are detailed. Points of extra caution include: cleanliness of the work area, tools, and mechanic's hands for eliminate dust and grit in the bearings; pairing the bearing cap with the correct connecting rod end; proper scrubbing and flushing with solvent of all areas where dirt may have already collected in the engine; and use of a torque wrench to tighten nuts and bolts.

Search terms: Bearings; Mechanic training; Tools; Maintenance /Engines

5/14 Occupant Protection

HS-009 262 Fld. 5/14

THE TOYOTA AIR BAG SENSOR

by Toyotaro Yamada

Published in *Experimental Safety Vehicles*, Washington, 1971, p55-6

Toyota uses a radar type sensor with which frontal crashes can be predicted in certain conditions. Characteristics of the system are described, and problems still needing solution are outlined.

Search terms: Air bag inflation devices /Radar; Sensors /Air bag inflation devices; Sensors /Radar; Air bag inflation devices /Performance characteristics

AVAILABILITY: In HS-820 157

HSL No. 71-19

HS-009 263 Fld. 5/14; 4/7

ANALYTICAL STUDY OF AIR BAG RESTRAINT

by Furusho

Published in *Experimental Safety Vehicles*, Washington, 1971, p57-62

Energy absorbing characteristics of the air bag are analyzed in the form of a simple model. Effects of the size of the gas outlet and of the bag volume and influence of the bag inflation on the secondary impact are examined. A mathematical model of an occupant with air bag installation is given, and simulation is made regarding the occupant behavior under the equation of motion of 7 degrees of freedom. Generally, the calculated and the measured values agree with each other and the practical worth of this model, although rather too simplified, is confirmed.

Search terms: Air bag restraint systems /Mathematical models; Equations of motion /Air bag restraint systems; Degrees of freedom /Air bag restraint systems; Energy absorption /Air bag restraint systems; Secondary collisions /Air bag restraint systems; Simulation models /Occupant protection

AVAILABILITY: In HS-820 157

HS-009 264 Fld. 5/14; 5/12

WHAT EVER HAPPENED TO AIR BAGS?

by Robert Lund

Published in *Popular Mechanics* v135 n2 p63-5, 168, 170 (Feb 1971)

The reasons for car manufacturers not installing air bags in new models are explored. The mechanism of air bag operation, including the function of the sensor, is explained. Questions car manufacturers want answered before installing air bags include: what happens to passengers who are not in upright, head-on position when the bag inflates; what

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nage may occur to passenger's ears in sound and pressure of bag inflation; what happens if the bag inflates in noncrash situation; how reliable will air bag be after years of storage; what protection can be devised for non ad-on-to-30°-angle-collision accidents; what happens to passengers smoking or wearing eye glasses when the bag inflates. Installation of some type of passive restraint in front seats is mandatory July 1973, and rear seats one year later. Some air bags will be available as options prior to that.

Search terms: Passive restraint systems; Air bag restraint systems/Hearing; Air bag restraint systems/Injuries; Air bag restraint systems/Reliability; Air bag restraint systems/Manufacturers

/18 Steering Control System

HS-009 265 Fld. 5/18

VEHICLE DYNAMICS IN SAFETY RESEARCH

by Seznec

Published in *Experimental Safety Vehicles*, Washington, 1971, p75-9

The handling quality of the experimental safety car is discussed. Ease of driving is considered a more modern concept than stability for European vehicles. Performance tests are described.

Search terms: Safety cars/Vehicle handling; Experimental automobiles/Vehicle handling; Vehicle stability/European vehicles; Vehicle stability/Experimental automobiles; Vehicle stability/Safety cars; Performance tests/European vehicles; Vehicle dynamics/Safety cars; Vehicle dynamics/Experimental automobiles; Safety research/Vehicle safety

AVAILABILITY: In HS-820 157

HS-009 266 Fld. 5/18

THE ISAM TEST PROGRAM

by Flaviano Moscarini

Published in *Experimental Safety Vehicles*, Washington, 1971, p93-5

The Italian Experimental Institute of Engines and Vehicles has been conducting tests for 10 years aiming at an objective evaluation of vehicle behavior, especially from the viewpoint of road safety. The most significant have been slalom tests in which vehicles drove a course aligned with rubber cones. These tests are discussed briefly.

Search terms: Vehicle handling/Road tests; Vehicle dynamics/Road tests; Vehicle control/Road tests; Automobile driving ranges/Cones

AVAILABILITY: In HS-820 157

HS-009 267 Fld. 5/18

FIRST SPECIFICATION DISCUSSION: VEHICLE RIDE AND HANDLING (BRAKING, STEERING, SUSPENSION AND DRIVE TRAIN)

by Matthes, Chairman

Published in *Experimental Safety Vehicles*, Washington, 1971, p109-18

A panel discussion.

Conference delegates from the U. S., Germany, Great Britain, Italy, Japan, France, and Sweden discussed braking, steering, handling, ride performance, suspension, and drive-train aspects of the experimental safety vehicle.

Search terms: Braking systems/Safety cars; Steering systems/Safety cars; Vehicle handling/Safety cars; Vehicle riding qualities/Safety cars; Suspension systems/Safety cars; Drivetrains/Safety cars; Braking systems/Experimental automobiles; Steering systems/Experimental automobiles; Vehicle handling/Experimental automobiles; Vehicle riding qualities/Experimental automobiles; Suspension

systems/Experimental automobiles; Drivetrains/Experimental automobiles

AVAILABILITY: In HS-820 157

HS-009 268 Fld. 5/18; 5/20

FIFTH WHEEL MOUNTING & MAINTENANCE

by Jack Lyndall, Esq.

Published in *Fleet Owner* v65 n5 p85-91, 94 (May 1970)

Problems arising from mounting fifth wheel on tractors are described. Maintenance of the fifth wheel and the king pin is discussed. Engineering drawings are included.

Search terms: Fifth wheel devices/Engineering drawings; King pins; Fifth wheel devices/Maintenance

5/22 Wheel Systems

HS-009 269 Fld. 5/22; 1/3

TIRE DISABLEMENTS AND ACCIDENTS ON HIGH-SPEED ROADS

by J. Stannard Baker; G. Declan McIlraith

Published in *Highway Research Record* n272 p24-38 (1969)

Presented at the Highway Research Board 48th annual meeting.

A study on a toll road in Illinois was undertaken to determine frequency of tire disablements, use and condition of tires, tire disablements not resulting in accidents, and tire disablements resulting in accidents. It was concluded that people who pay to use a toll road probably have better tires than average, which might make disablements and accidents less than elsewhere. However, high speeds are more likely to cause

5/22 Wheel Systems
HS-009 269 Fld. 5/22; 1/3

disablements and resulting accidents. It could not be determined to what extent these opposing considerations may offset each other.

Search terms: Toll roads/Tire failures; Toll roads/Tire failure caused accidents; High speed/Tire failure caused accidents; Tire quality/Surveys; Toll roads/Illinois; High speed highways/Tire failures; High speed highways/Tire failure caused accidents

HS-009 270 Fld. 5/22

LIQUID-MOLDED CORDLESS TIRE CHALLENGES BEST RADIALS

by Joseph M. Callahan, Ed.

Published in *Automotive Industries* v142 n8 p67-70 (15 Apr 1970)

Firestone's Central Research Laboratories announce the development of a rubbery material that can be produced in liquid form. Poured from a bucket into a tire mold, it is claimed to produce a tire as good as or better than any of the best radials. It is promised in many colors.

Search terms: Cordless tires/Molding; Cordless tires/Synthetic rubber; Cordless tires/Color; Cordless tires/Costs; Cordless tires/Loading tests; Cordless tires/Slip; Cordless tires/Wear tests; Cordless tires/Retreaded tires; Cordless tires/Radial tires

HS-009 271 Fld. 5/22

TYRES AND NATURAL RUBBER

by A. Schallamach

Published in *Rubber Development, NR Technology* pt1 n3 p1-11 (1970)

18 refs

Presented at the Annual General Meeting of the Swedish Inst. of Rubber Technology, Tampere, Finland, 5 Jun 1969.

Vehicle production increases at between 8 and 9% a year, but natural rubber production increases at about 3% per year. Therefore, it is important to use available natural rubber to the best advantage. Formulation of tire rubber is a compromise between often conflicting demands. For example, in winter tires, oil-extended natural rubber has less friction than natural rubber on ice, but more on wet roads. Its cold weather wear resistance is greater than synthetic treads, but may wear more if used year round. It appears that oil-extended natural rubber or oil-extended natural rubber/butadiene rubber is the best compromise for winter tires used as such, because good skid resistance on ice and wet roads are then combined with excellent wear resistance. Natural rubber also plays an important role in large tires and aircraft tires. Low heat build-up and rolling resistance, building tack and mechanical strength needed for rugged conditions of service are a set of properties met only by natural rubber.

Search terms: Tire materials/Rubber; Tire materials/Wear; Rubber compounds/Butadienes; Rubber compounds/Styrene resins; Tire materials/Rubber compounds; Tire treads/Heat; Tire materials/Synthetic rubber; Wet road conditions/Tire performance; Skid resistance/Tire materials; Tire treads/Cracking; Tire sidewalls/Cracking; Tire materials/Cracking; Snow tires/Tire materials; Tire wear

HS-009 272 Fld. 5/22; 5/20

DESIGNER DESCRIBES HOW TIRES REACT TO APPLIED FORCES

by Jack A. Davisson

Published in *SAE Journal* v78 n4 p50-53 (Apr 1970)

A tire is elastic — when something presses against it, it deforms. Three important cases are of special interest: 1. Radial deflections, caused by vehicle weight carried. 2. Lateral deflections, the result of cornering forces. 3. Tractive or rotational deformations, from applied torques. Compiled data show many factors affect a tire's reactions and that these reactions are not linear. On the contrary, they are interdependent and strongly affected by the type of construction, inflation pressure, and other factors. The relationships described here apply to truck and bus tires strictly to other types by extension.

Search terms: Radial tires; Bias tires; Bias belted tires; Tire loads; Tire deflection; Tire forces; Tire spring rates; Truck tires; Bus tires

HS-009 273 Fld. 5/22

RESEARCH FOR A UNIFORM QUALITY GRADING SYSTEM FOR TIRES. PT. 1. BACKGROUND AND RATIONALE

by F. Cecil Brenner

National Bureau of Standards

Jul 1969 11p 7 refs
 Contract FH-11-6090
 Report no. NBS-10-066

In summary, the several proposed tests provide a measure of each of Morton's required properties except comfort. In table below are shown the properties being tested by each test. The three laboratory procedures test load carrying capacity and durability; but each tests for a different aspect of those properties. For example, the endurance test determines durability in terms of the tire's ability to resist damage as a result of long term flexing whereas the wheel speed capability test measures the durability with respect to flexing a high temperature. As indicated above the tread wear and traction tests are interrelated in a complex way to the tire/ground forces.

Table. Relations of tests to properties:

Test	Properties Tested
Endurance	Load carrying capacity Durability
Wheel Speed Capability	Load carrying capacity Durability Tread life as related to thickness of rubber
Impact Resistance	Load bearing capacity Durability Tread life as related to thickness
Tread, Wear	Tire/ground forces
Traction	Tire/ground forces

Search terms: Tire tests; Tire loads / Laboratory tests; Durability / Tire tests; Tire load limits / Laboratory tests; Tire treads / Laboratory tests; Tire wear measurement; Tire traction / Laboratory tests; Tire road contact forces; Tire grading; Impact tolerances / Tires; Tire properties; Wheel speed capability / Tire tests; Quality control / Tire tests

HS-009 274 Fld. 5/22

RESEARCH FOR A UNIFORM QUALITY GRADING SYSTEM FOR TIRES. PT. 2. WHEEL SPEED CAPABILITY TEST

by F. C. Brenner; J. Mandel; B. G. Simson

National Bureau of Standards

Jun 1969 22p 5 refs
Contract FH-11-6090
Report no. NBS-10-067

A test procedure defining a property called wheel speed capability has been described. Its results, evaluated by rank analysis, show that the test reveals similarities between nominally identical tires and that it is capable of revealing differences in the measured property, due to the effects of systematic variables, such as size, manufacturer, and nominal grade. A method for scaling quality with respect to wheel speed capability has been devised. It leads to the same conclusions, with regard to the tires tested in this study, as an analysis based on the original data of the test.

There are significant differences in the wheel speed capability by the type of tire tested. In decreasing order the ranking for the tires included in this study is 70 series, radial, bias ply (exclusive of premium grade), winter, and bias ply premium tires.

Search terms: Wheel speed capability / Tire tests; Wheel speed capability / Tire sizes; Wheel speed capability / Tire grading; Quality control / Wheel speed capability; Tire failures / Mileage; Tire grading / Ranking

HS-009 275 Fld. 5/22

RESEARCH FOR A UNIFORM QUALITY GRADING SYSTEM FOR TIRES. PT. 2. WHEEL SPEED CAPABILITY TEST

by F. C. Brenner; J. Mandel; B. G. Simson

National Bureau of Standards

Published in *Rubber Chemistry and Technology* v42 n5 p1450-61 (Dec 1969)

22p 5 refs
Contract FH-11-6090
Report no. NBS-10-067

A test procedure defining a property called wheel speed capability has been described. Its results, evaluated by rank analysis, show that the test reveals similarities between nominally identical tires and that it is capable of revealing differences in the measured property, due to the effects of systematic variables, such as size, manufacturer, and nominal grade. A method for scaling quality with respect to wheel speed capability has been devised. It leads to the same conclusions, with regard to the tires tested in this study, as an analysis based on the original data of the test. There are significant differences in the wheel speed capability by the type of tire tested. In decreasing order the ranking for the tires included in this study is 70 series, radial, bias ply (exclusive of

premium grade), winter, and bias ply premium tires.

Search terms: Wheel speed capability / Tire tests; Wheel speed capability / Tire sizes; Wheel speed capability / Tire grading; Quality control / Wheel speed capability; Tire failures / Mileage; Tire grading / Ranking

HS-009 276 Fld. 5/22

RESEARCH FOR A UNIFORM QUALITY GRADING SYSTEM FOR TIRES. 3. BREAKING ENERGY

by B. G. Simson; J. Mandel; B. C. Brenner

National Bureau of Standards

Published in *Rubber Chemistry and Technology* v43 n2 p356-69 (Mar 1970)

Reprint.

A test procedure designed to classify tires according to their average breaking energy has been applied to 127 tires. The test reveals significant differences between tires of nominal manufacturers grades. In decreasing order the grades ranked as follows: 110 level, 80 and 90 level, and 100 level. Tires from different manufacturers showed significant differences with respect to the breaking energy, but the difference was not always consistent from grade to grade. There is some evidence that premium and radial ply tires have higher breaking energies than the other tire types in the selection. A method for scaling tires with respect to their breaking energy has been devised. When applied to the results of the above test, it leads to the same conclusions as an analysis based on the original data.

Search terms: Tire tests / Breaking energy; Tire grading / Breaking energy; Tire grading / Ranking; Breaking energy / Ranking

NHTSA DOCUMENTS

HS-009 277 Fld. 5/22

TIRE TRENDS IN THE '70'S

by Arthur Perrow

Published in *Motor* (New York) v135 n1 p38-41 (Jan 1971)

Innovations in tires and tire safety devices are described. A list of tire manufacturers' approved code marks is included. Sensors and warning systems are among the safety devices described.

Search terms: Sensors/Tire safety; Warning systems/Tire safety; Tire characteristics; Coding systems/Tires

HS-009 278 Fld. 5/22; 2/4

AN INVESTIGATION CONCERNING STUDDED TYRES, WITH SPECIAL REFERENCE TO PAVEMENT WEAR, BASED ON LITERATURE STUDIES

by Ake Rosengren

Sweden Statens Vaginstitut

1969 30p 19 refs
Report no. SR-81-A

The history and design of studs and studded tires are discussed. Their skid resistance and rolling resistance are described. Their effect on road surface wear is discussed in terms of experiments made in West Germany, the U. S., Finland, and Norway. The influence of pavement design on resistance to wear by studded tires is discussed. The legality of studded tires in several countries is also discussed.

Search terms: Studded tires/History; Tire rolling resistance/Studded tires; Tire skid resistance/Studded tires; Pavement wear/Studded tires; Wear resistance/Pavement wear; Studded tires/Legal factors; Pavement wear/West Germany; Pavement wear/United States; Pavement wear/Finland; Pavement wear/Norway

NHTSA DOCUMENTS

NHTSA Contractor Reports

HS-800 372 Fld. 5/22

TIRE REPAIR METHODS AND MATERIALS. FINAL REPORT

by Calvin W. Cole

Retreading Research Associates, Inc.

1 Oct 1970 47p
Contract FH-11-7196
Report no. PB-196 952

The objective of this study is to assess the safety adequacy of tire repair methods and materials as used by various repair and maintenance facilities. A survey was made of 1,732 potential tire repair facilities. The majority of available brands of repair materials currently on the market were included in the study. Of the tires repaired in the first phase of the study, 47% of the repairs were failures in static tests. Of tires repaired in the second phase of the study, 37% failed, even though repairs had been made by experienced tire people under laboratory conditions. The third phase involved repair of used tires with multiple repairs, which were then tested on the highway under high stress, load, and inflation conditions. All but one of these tires performed satisfactorily. The materials used in tire repairing appear to be satisfactory. A major cause of tire repair failures is poorly performed repairs. Road tests are recommended as the most satisfactory means of testing repaired tires.

Search terms: Tire repair/Road tests; Tire repair/Laboratory tests; Tire materials/Tire repair; Tire repair/Materials tests; Tire repair/Tire failures; Tire loads/Tire failures; Tire inflation pressure/Tire failures; Failure stress/Tire failures; Failure stress/Tire repair; Tire repair/Static tests; Tire safety/Tire repair

AVAILABILITY: NTIS

HS-800 460 Fld. 1/1

COORDINATED ACCIDENT RESCUE, ENDEAVOR, STATE OF MISSISSIPPI. FINAL REPORT. VOL. 1. OPERATION STRUCTURE AND PROCEDURES

by J. Edwin Clark; L. Ray Johnson; M. Wayne Parker; Donald W. Boatwright; Donald F. Fitzgerald

Mississippi State Univ.

Sep 1970 183p
Contract FH-11-7146

Project CARE-SOM, a 15-month study of a total emergency medical service system, is described. The objective was to develop and evaluate a comprehensive and integrated plan for a total emergency medical care system composed of ground ambulances and helicopters. Findings and conclusions are presented in regard to emergency roadside telephones; ground ambulance response characteristics; medical attendant training and performance; emergency medical communications; helicopter operations and performance; a simulation model for a rescue system; and comparison of helicopter and ground ambulance response characteristics.

Search terms: Emergency medical services/Evaluation; Emergency medical services/Mississippi; Ambulances; Helicopter ambulances; Roadside telephones; Emergency medical services/Time factors; Occupant rescue; Ambulance personnel; Communication systems/Emergency medical services; Simulation models/Emergency medical services

AVAILABILITY: NTIS

HS-800 461 Fld. 1/1

COORDINATED ACCIDENT RESCUE ENDEAVOR, STATE OF MISSISSIPPI. FINAL REPORT. VOL. 2. APPENDICES

by J. Edwin Clark; L. Ray Johnson; M.

NHTSA DOCUMENTS

HSL No. 71-19

Wayne Parker; Donald W. Boatwright;
Donald F. Fitzgerald

Mississippi State Univ.

Sep 1970 248p
Contract FH-11-7146

Project CARE-SOM was a study to develop and evaluate a comprehensive and integrated plan for a total emergency medical care system composed of ground ambulances and helicopters. This volume contains documentation for the study. Included are information supplied by attendants and hospitals; information on the helicopters and their operation and equipment; log of the helicopter missions; the simulation program and print-out.

Search terms: Emergency medical services /Evaluation; Emergency medical services /Mississippi; Ambulances; Helicopter ambulances; Occupant rescue; Simulation models /Emergency medical services; Accident report forms

AVAILABILITY: NTIS

HS-800 463 Fld. 3/1

ALCOHOL SAFETY ACTION PROJECT EVALUATION MANUAL FINAL REPORT

by David M. Promisel; Richard D. Blomberg; John F. Oates

Dunlap and Associates, Inc.

Mar 1971 280p refs
Contract FH-11-7541
Report no. PB-199 182

Alcohol Safety Action Projects are federally funded, community based campaigns employing integrated sets of countermeasures against the problems of drinking-driving. They are administered by the National Highway Traffic Safety Administration and constitute a major element of its total alcohol program. The purpose of this manual is to provide guidance and support for the evaluation of individual projects by promoting an understanding of the evaluation process, providing a working knowledge of

evaluation, promoting a common scope of evaluation on the part of every project, and insuring sufficient consistency of practice so that the projects can be compared. Survey techniques and roadside interview techniques are detailed.

Search terms: Alcohol usage deterrents /Program evaluation; Alcohol usage deterrents /Community support; Alcohol usage deterrents /Manuals; Program evaluation /Manuals; Drinking drivers /Safety campaigns; Alcohol usage deterrents /Interviews; Alcohol usage deterrents /Surveys; Safety campaigns /Program evaluation; Alcohol usage deterrents /National Highway Traffic Safety Administration

AVAILABILITY: NTIS

HS-800 467 Fld. 5/4

CRASHWORTHINESS OF VEHICLE STRUCTURES. PASSENGER CAR ROOF STRUCTURES PROGRAM. FINAL REPORT

by Robert A. Carl; George K. Williams

Lockheed-Georgia Co.

5 Mar 1971 81p
Contract FH-11-7549

Crashworthiness characteristics of representative 1970 model passenger car roof structures were studied, using both static and dynamic tests to establish a correlation between these test types and to obtain information from which a performance specification for roofs can be developed. Five bodies and five complete automobiles weighing 2,500 to 4,000 pounds were used as test specimens. Structural characteristics are summarized in terms of ultimate strength (maximum loads), deflection, acceleration, and strain at selected points on the body. Correlation between static and dynamic testing techniques has been developed with a moderate degree of accuracy. The repeatability of drop tests is not good because of the number of uncontrolled variables. Recommendations for design

criteria for future roof structures are presented.

Search terms: Roofs /Crashworthiness; Roof failures; Roof supports; Roofs /Static tests; Roofs /Dynamic tests; Roofs /Performance characteristics; Loads (forces) /Roofs; Deflection /Roofs; Acceleration /Roofs; Strain (mechanics) /Roofs; Drop tests /Roofs; Roofs /Specifications; Ultimate strength /Roofs

AVAILABILITY: NTIS

HS-800 468 Fld. 2/3

HIGHWAY DEBRIS HAZARD CONTROL AND CLEANUP STUDY. FINAL REPORT. VOL. 1. TECHNICAL REPORT

by E. R. Streich; J. F. Knudson; B. D. Miller

Systems Development Corp.

19 Mar 1971 175p refs
Contract FH-11-7274
Report no. TM-L-4561/001/00

The purpose of this study was to examine the current state of the art of debris hazard control and cleanup program planning and operations at state, county, and local levels of government. Primary attention was focused on the broad range of activities associated with the response of emergency service organizations, both public and private, to a highway emergency debris situation. It was found that a small number of unusual incidents cause major problems, but the majority of incidents are minor; that in rural areas debris cleanup gets a lower priority than emergency medical services because of limited resources, and response requirements are different; that most localities cannot handle overload conditions without substantial delays; that emergency response capability is seldom seen from the perspective of the total system; and that no single highway safety program standard appears to encompass the range of functions in highway emergency services.

**NHSTA Contractors Report
(Cont'd.)****HS-800 468 Fld. 2/3 (Cont'd.)**

Search terms: Debris/Hazards; Debris removal/State of the art studies; Debris removal/Emergency road services; Debris removal/Rural areas; Debris removal/Urban areas; Debris removal/Time factors; Debris removal/Safety standards; Debris removal/Highway standards; Debris removal/Program evaluation; Debris removal/State government; Debris removal/Local government

AVAILABILITY: NTIS

HS-800 469 Fld. 2/3**HIGHWAY DEBRIS HAZARD
CONTROL AND CLEANUP
STUDY. FINAL REPORT. VOL. 2.
DEBRIS INCIDENT CASE
STUDIES**

Systems Development Corp.

19 Mar 1971 207p
FH-11-7274

This document presents 36 case studies of actual highway debris incidents reconstructed from interview and records data obtained in a sample of representative locations. The study team sought to obtain data on a wide variety of incidents involving multiple or "chain reaction" vehicle collisions; cargo spillages; hazardous materials spillages; presence of foreign objects; locations presenting problems of emergency service access; presence of unusual highway environmental conditions; injuries or fatalities. Each case study includes incident data, sequence of events, and discussion. There are 17 rural and 19 urban debris incidents described.

Search terms: Debris removal/Urban areas; Debris removal/Rural areas; Debris removal/Case reports; Debris/Hazards; Debris removal/Interviews; Debris removal/Surveys; Multiple vehicle accidents/Debris removal; Hazardous materials/Debris removal; Foreign objects/Debris removal; Accident location/Debris removal; Emer-

gency road services/Debris removal; Environmental factors/Debris removal; Fatalities/Debris removal; Injuries/Debris removal; Freight/Debris removal; Debris removal/State of the art studies

AVAILABILITY: NTIS

HS8-800 470 Fld. 2/3**HIGHWAY DEBRIS HAZARD
CONTROL AND CLEANUP
STUDY. FINAL REPORT. VOL. 3.
PLANNING AND OPERATIONS
HANDBOOK**

Systems Development Corp.

19 Mar 1971 63p 17 refs
Contract FH-11-7274

This handbook contains guidance materials for planning and operational personnel in public and private highway emergency service organizations.

Search terms: Debris removal/Manuals; Debris removal/Planning; Debris/Hazards; Emergency road services/Debris removal

AVAILABILITY: NTIS

HS-800 471 Fld. 3/4**METHODOLOGICAL CONSIDERATIONS
IN CONDUCTING AND
EVALUATING ROADSIDE RESEARCH
SURVEYS. FINAL REPORT**

by M. W. Perrine; Irwin W. Maranville

Vermont Dept. of Mental Health

Feb 1971 75p 5 refs
Contract FH-11-7543

Prepared in cooperation with Vermont Univ.

Methodology for a roadside survey of behavior of drivers who are not involved in accidents is described. A letter from the governor of Vermont is presented as the first explanation for being stopped

for a road-block. Techniques for the police officer and the interviewer in handling the motorist are explained. Handling the data with respect to privacy and quality control is outlined. Procedures for coping with the alcohol-impaired driver are suggested. The questionnaire used by the interviewer is included. The following subjects are covered: seat belt usage; socioeconomic data; health history; driving history; smoking history; drinking history; driving record; and passenger information.

Search terms: Driver characteristics/Research methods; Driver characteristics/Roadblocks; Driver characteristics/Surveys; Driver characteristics/Interviews; Driver characteristics/Questionnaires; Driver intoxication/Roadblocks; Alcohol breath tests/Roadblocks; Seat belt usage/Roadblocks; Passengers/Roadblocks; Socioeconomic data/Drivers; Driver physical fitness/Questionnaires; Driver records/Questionnaires; Smoking/Questionnaires; Alcohol usage/Questionnaires; Information systems/Privacy; Information systems/Quality control

AVAILABILITY: NTIS

HS-800 485 Fld. 5/22**TIRE FRICTION. A STATE-OF-
THE-ART REVIEW. FINAL REPORT**

by W. E. Meyer; M. O. Schrock

Pennsylvania State Univ.

Apr 1969 75p 60 refs
Contract CST-429; FH-11-6090
Report no. S-34

A series of skid-tester correlation studies are used to illustrate the difficulty of making "absolute" friction measurements on the tire-pavement pairing. The frictional demands of traffic are explained and the status of the theory of rubber friction is reviewed in the light of experimental findings. Special attention is given to the mechanisms of water

displacement by the tire and the resulting coefficients on wet surfaces. The frictional performance of various tires in various operating modes is discussed and examples are given. Since theory is capable of dealing with real problems only in an approximate fashion, methods of obtaining tire performance by experimental means are reviewed at some length. Because tire friction changes with tread wear, current hypotheses on wear are cited.

Search terms: Tire tests /Friction; State of the art studies /Friction tests; Locked wheel friction /Tire pavement interface; Wet road conditions /Friction; Rubber compounds /Friction; Rubber /Temperature; Tire pavement interface /Pressure; Hydroplaning; Speed /Friction; Tire wear /Friction; Dry road conditions /Friction; Tire performance /Friction

AVAILABILITY: NTIS

NHTSA Staff Speeches, Papers, etc.

HS-810 158 Fld. 5/11

RELIABILITY AND MAINTAINABILITY REQUIREMENTS FOR MOTOR VEHICLES

by Welferd M. Redler

National Highway Traffic Safety Administration

1971 16p 9 refs

Reliability and maintainability are recognized factors in the safety of motor vehicles. The National Highway Traffic Safety Administration plans to incorporate requirements for both in the motor vehicle safety standards. Considerations are being given to existing and possible new reliability requirements, data availability, terminology, production lead time, design changes, compliance surveillance, and consumer economics. The first reliability requirements are not scheduled to be effective before January 1, 1975.

Search terms: Reliability /Vehicle

safety standards; Maintainability /Vehicle safety standards; Reliability /Economic factors; Maintainability /Economic factors; Safety standards compliance; Failures /Reliability; Service life /Reliability

AVAILABILITY: NTIS

HS-810 160 Fld. 5/4

THE UNITED STATES ESV PROGRAM - OVERVIEW

by John A. Edwards

National Highway Traffic Safety Administration

Published in *Experimental Safety Vehicles*, Washington, 1971, p21-3

The development of the experimental safety vehicle is outlined, particularly the 4,000 pound family sedan. Development of smaller cars is also planned. Crashworthiness is the highest priority in the program.

Search terms: Crashworthiness /Safety cars; Crashworthiness /Experimental automobiles

AVAILABILITY: In HS-820 157

HS-810 161 Fld. 5/4

THE UNITED STATES 4000 LB. EXPERIMENTAL SAFETY VEHICLE - PERFORMANCE SPECIFICATION

by Albert Slechter

National Highway Traffic Safety Administration

Published in *Experimental Safety Vehicles*, Washington, 1971, p24-45

Aspects of the crashworthiness of the experimental safety car include front bumpers, rear bumpers, side structures, interior design, restraint systems, braking performance, stability. The systems analysis approach has been used.

Search terms: Crashworthiness /Safety cars; Crashworthiness /Experimental automobiles; Systems analysis /Crashworthiness; Impact tolerances /Safety cars; Impact tolerances /Experimental automobiles; Performance characteristics /Safety cars; Performance characteristics /Experimental automobiles; Specifications /Safety cars; Specifications /Experimental automobiles; Bumper standards; Side impact bars; Interior design /Safety cars; Interior design /Experimental automobiles; Restraint systems /Safety cars; Restraint systems /Experimental automobiles; Brake design /Safety cars; Brake design /Experimental automobiles; Vehicle stability /Safety cars; Vehicle stability /Experimental automobiles

AVAILABILITY: In HS-820 157

HS-810 162 Fld. 4/4; 4/2

FEDERAL VIEW OF THE ANNUAL WORK PROGRAM

by James E. Wilson

National Highway Safety Bureau

26 Oct 1970 12p

Presented before the National Safety Congress, Pick-Congress Hotel, Chicago, Ill.

The role of Federal funds in the national highway safety program is seen as a planning, guiding, and coordinating one. Becoming mandatory for fiscal year 1972, an annual work program will be required from each state. This would document the state's plans, including measures of effectiveness, tasks, and milestones, and provide a flexible framework for program management at state level. The program would be used to evaluate the effectiveness of tasks, to plan the most efficient allocation of funds to various activities, and to improve programs by recycling through the

JULY 2, 1971

NHTSA DOCUMENTS

**NHTSA Staff Speeches, Papers, etc.,
(Cont'd.)**

HS-810 162 Fld. 4/4; 4/2

planning process. Unless some type of systems approach is used, program gaps will not be revealed, and counter-measures developed to overcome them.

Search terms: Federal state relationships; Highway safety programs / Planning; Highway safety programs / Federal role; Highway safety programs / State planning

AVAILABILITY: NHSB

NHTSA Imprints

HS-820 113 Fld. 4/5

**RESEARCH REPORTS OF THE
NATIONAL HIGHWAY TRAFFIC
SAFETY ADMINISTRATION; A
BIBLIOGRAPHY, 1967-1970**

National Highway Traffic Safety
Administration

Apr 1971 148p refs

The research reports of the National Highway Traffic Safety Administration cited in this bibliography are the products of contracts that fulfill objectives of the administration in the fields of highway and motor vehicle safety. The bibliography is up to date as of December 1970.

Search terms: Contracts / Bibliographies; Highway safety / Bibliographies; Vehicle safety / Bibliographies

AVAILABILITY: NTIS

HS-820 157 Fld. 5/4

**EXPERIMENTAL SAFETY VEHICLES. REPORT ON THE FIRST
INTERNATIONAL TECHNICAL**

**CONFERENCE, PARIS, 25-27
JANUARY 1971**

National Highway Traffic Safety
Administration

1971 153p

This conference includes technical presentations on the experimental safety car from each of six countries: the United States, Germany, Japan, France, Italy, and the United Kingdom. Three panel discussions of safety car specifications are also included.

Search terms: Safety cars / Conferences; Experimental automobiles / Conferences

**AVAILABILITY: NTIS; includes
HS-009 222-3; 009 232; 009 240-248;
009 262-3; 009 265-7; 810 160-1**



executive summary

ASYNOPSIS OF A RECENTLY RELEASED NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION RESEARCH REPORT

IMPACT CAPABILITY OF SAFETY GLAZING MATERIALS FINAL REPORT

The prime objective of Contract FH-11-7277 was to establish a program to define as accurately as possible the drop height ranges within which various safety glazing materials would suffer cracking, breakage, or penetration when impacted by the various impact tools specified in the American Standard Association (ASA) Safety Code Z26.1-1966.

Contract FH-11-7277
Southwest Research Institute
8500 Culebra Road
San Antonio, Texas 78228
DOT/HS-800 305 PB-195 040

Award Amount: \$22,815.00
Date Report Due: 6/30/70
Date Report Rec'd: 9/15/70
Release Date: 11/3/70

BACKGROUND

Early in 1969 a number of investigations were launched by the several directly concerned offices of the National Highway Safety Bureau to gather information for use in directing objectives, structuring new safety compliance standards, and in amplifying certain existing documents.

One of the existing standards was FMVSS No. 205, Glazing Materials - Passenger Cars, Multipurpose Passenger Vehicles, Motorcycles, Trucks, and Buses. (*) The basic standard had been established to be a functional part of the National Traffic and Motor Vehicle Safety Act of 1966, PL89-563. As established and legally effective on January 1, 1968, FMVSS No. 205 sets forth the requirement of conformance of automotive glazing materials to United States of America Standards Institute Safety Glazing Materials for Glazing Motor Vehicles Operating on Land Highways, ASA Standard Z26.1-1966, July 15, 1966. (**)

* Federal Motor Vehicle Safety Standard No. 205 (32F.R. 2414 as amended thereafter). Glazing

Materials - Passenger Cars, Multipurpose Passenger Vehicles, Motorcycles, Trucks and Buses.

** American Standard Safety Code for Safety Glazing Materials for Glazing Motor Vehicles Operating on Land Highways. Sponsored by Insurance Institute for Highway Safety; designated Z26.1-1966 and approved by the American Standards Association on July 15, 1966. Redesignated as a USA Standard on August 24, 1966. upon the reconstitution of the ASA as the United States of America Standards Institute. There was no change in the index identification or technical content of the Standard at that time. There is, however, recent reference to this document as USA Z26.1-1966.

Principally, FMVSS No. 205 is established to provide a requirement and a procedure which, by its implementation, would be influential in the retention of vehicle occupants and in the reduction of their injuries in the event of a collision. Additionally, it is to provide a means of practical analysis of the Structural performance of this material.

In the course of establishing appropriate specifications, The Offices of Standards on Crash Injury Reduction recognized that the test data already gathered via ASA Z26.1-1966 was in need of supplementation if the mission of FMVSS No. 205 was to be accomplished. This need arose from the fact that all available data had been obtained using an "acceptance" test approach, wherein a material is tested only a few times at a given stimulus level. With such data, it is possible only to derive an estimate of whether the response level of interest is above or below the test level; the actual location of the response level remains unknown. In view of the obvious importance of locating the actual response levels, a requirement was issued for the test program described in the report.

The ASA Standard Z26.1-1966 describes in detail 32 various tests to be used in evaluating various characteristics of safety glazing materials which are to be used as glazing in motor vehicles operating on land highways. Performance data from four of these tests were selected to provide direct comparison of the structural capability of suitable glazing material. The features of the selected tests were chosen to provide direct comparison of the structural capability of suitable glazing material.

The features of the selected tests were varied in terms of the "impact-tool" to be used. It should be established that it was never the intention that FMVSS No. 205 specify the direct application of the complete ASA Z26.1-1966 as the functional compliance standard, but that designated tests would be used as starting point procedures insofar as the mechanism of the program was concerned. The method and system of accumulating and evaluating the data resultant from the drop testing was examined along with the information collected in the interest of developing a comprehensive and practical compliance test.

MAJOR FINDINGS AND CONCLUSIONS

Excluded from the report are conclusions regarding whether the individual materials should be considered as having either passed or failed the requirements of the Standard.

In consideration of the test results and findings, the following is considered to be appropriate:

- Available and normally utilized glazing materials were represented by the American Standard AS-1 laminated safety plate glass, AS-2 laminated safety sheet glass and AS-2 (1/4) plate tempered safety glass specimens. In each case the fracture pattern

was as anticipated. Laminated glass cracked and broke on impact; the resulting glass slivers and pieces were numerous and sharp. Penetrations caused a scattering of small to medium-sized, sharp fragments. The tempered glass (of the kind ordinarily used in automobile side windows) experienced failure by impact that was characterized by a deterioration into numerous small pieces that were sharp and did noticeably more damage to the leather shot bag than did the fragile slivers of AS-1 glass. In a documentary film using standard and high-speed cine-photography, a typical high rebound of the impact tool (when the glass remained unfailed), and the explosive type deterioration and scatter of the residue at typical specimen failure was evident. A typical bell-tone sound for the "no-failure" impact on the tempered glass was recorded.

- New Laminates by the Glaverbel Societe Anonyme of Brussels, Belgium and the Corning Glass Works of New York were tested within the same limits as the previously mentioned glass samples. Characteristically, these new laminates seemed to hold the many small fragments of glass in place on an extremely flexible laminating layer. During an initial failure, the Glaverbel material reduced to numerous, well-held, pieces unless it was impacted in a mode well beyond its initial failure condition. All impacts in this series were conducted with a 5-pound steel sphere. One specimen failed at the 4-ft level with minimal loosening of glass fragments. More extensive crack propagation and the development of a secondary target ring resulted from the 5-ft drop - again with very little loss of glass fragments. More extensive crack propagation and the development of a secondary target ring resulted from the 5-ft drop again with very little loss of glass fragments. A drop from 22 feet did result in considerable particle loosening on the impact side but noticeable reduced fine cracking throughout the part of the specimen away from the impact center. The interlayer did not rupture.
- Although the Glaverbel appeared to be a hard plastic material, its fracture characteristics were more like glass. Physical examinations of the glass revealed no apparent difference between the two sides of the laminated specimens. Additionally, it made no difference which side of the material was hit. In every test variation (whether it was a drop-tool change or a drop-height change) a new set of failure characteristics was generated; on the other hand, the tests yielded discrete procedural criteria.

- In appearance, the Corning Chemcor differed from the Glaverbel; the former did not demonstrate a greenish tint noted in the Glaverbel, and it was readily discernible that the Corning specimens were constructed of two different glass thicknesses. It was also known (by specification), that the thin side of the Chemcor was tempered. Because of this, tests were conducted against both the tempered (thin) and non-tempered (thick) sides of the specimen. Results of the test and the response distribution, show that the behavior of the Corning Chemcor specimens depend on which side of the material is hit. Impact against the nontempered side seemed to offer an advantage in the case of the four tools used, but in particular for the 11-pound shot bag and 1/2-pound steel sphere. Independent of the side of impact and for all failures, the nontempered layered cracked. In some instances, the tempered layer also cracked. Generally the Chemcor exhibited a tendency toward dispersing few if any loose fragments on impact. In addition the laminating interlayer was very flexible and tough having torn in only one instance and then retaining the glass particles very well.

- Acrylic plastic materials used in various thicknesses were found to be completely unlike the glass materials in that a fracture of the plastic resulted in a few, relatively large, sharp edged pieces. Qualitative observations showed that a sharp, highly concentrated blow, such as that inflicted with the 1-in. diameter face of an ordinary claw-hammer, would result in multiple small sharp fragments provided the underneath support of the specimen was such that it spanned a very short distance of about 2". It appeared that both the large and small pieces would be relatively hazardous as flying debris.

- Polycarbonate samples, also tested, were shown to be impervious to any of the programmed imposed stimuli within the range of the investigation.

- It was observed tangentially to the program that (a) the polycarbonate material was easily scratched as compared to the glass materials, and (b) a steel BB shot would permanently indent the specimen. A considerably more extensive program will be necessary to determine the fracture mechanism of this glazing material.

— Steel BB shot and lead pellets were fired

from a Crosman Air Rifle at various barrel pressures and at distances from 1 foot to 36 feet. This was done to determine whether or not a relatively low energy ballistic system would be suitable for initiating a failure of the polycarbonate. The materials mentioned were tested for comparison to the polycarbonate. It was observed that all materials, except the polycarbonate, could be damaged to some extent in terms of the failure criteria of the program. The polycarbonate samples, at the maximum condition, were indented slightly with the BB shot and were apparently unaffected by the "flattened" lead pellet.

- In terms of resistance to penetration and/or cracking by impact, within the limits of the tests conducted, a ranking of the materials is given in the report. The rating is: (a) by resistance to penetration from impact from 1 (best) through 12 and then (b) by resistance to cracking from impact. Fragment dispersion and cracking density are not considered in the ranking.
- In general, the test equipment specifications contained in the Standard are appropriate and adequate. They provide the opportunity for an individual laboratory to vary equipment design but the important test variables, such as the design of the impact tools and the specimen holding frame, are controlled.
- Break response criteria were found to be of minimal practical usage because of difficulties in different rating between a "break" and "crack." It is possible that a meaningful definition could be derived, but it also appears that development of such a definition would involve time and expense that are not warranted at this time.
- A most significant conclusion reached in the program was that the current Standard procedure, which involves a limited number of test drops from a single drop height, can lead to an unacceptable degree of error for compliance test results. For example, it was shown how the close proximity of the material response distribution to the Standard drop height criterion might easily result in no better than a 60-percent chance of identifying a noncompliant sample. It was also shown that the test procedure utilized for these investigations would be more effective with little or no increase in the number of test samples.

The Contract Manager has certified that the Contractor's work has been satisfactorily completed and that all contractual obligations have been met.

The opinions, findings and conclusions expressed in this summary are those of the contractor and not

necessarily those of the National Highway Traffic Safety Administration.

Availability: NTIS (Formerly Clearinghouse), U.S. Department of Commerce, Springfield, Va. 22151. Order DOT/HS-800 305 or PB-195 040 in paper copy (PC) or in microfiche (MF).

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